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Financial regulation and financial stability in Kenya

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FINANCIAL REGULATION AND FINANCIAL STABILITY IN KENYA

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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ACRONYMS

ATM	Automated Tailor Machine
BCBS	Basel Committee on Banking Supervision
CBK	Central Bank of Kenya
GDP	Gross Domestic Product
GFDD	Global Financial Development Data
IRF	Impulse Response Function
LICs	Low Income Countries
LMICs	Low Middle Income Countries
NSE	Nairobi Stock Exchange
ROA	Return On Asset
SVAR	Structural Vector Autoregressive
UN	United Nations
VAR	Vector Autoregressive
WB	World Bank

ABSTRACT

The main objective of this project is to examine the effectiveness of Basel regulations on the financial stability of Kenya. In order to achieve this objective, quarterly time-series data ranging from 1995:1 to 2019:4 is employed. The empirical methodology of the study is conducted using a Structural Vector Autoregressive model. Five endogenous variables (z-score, bank capital to total asset ratio, regulatory quality index, liquidity assets to deposits and short funding ratio and bank regulatory capital to risk-weighted assets ratio) are used. Innovations in capital adequacy ratio has an economically significant effect on the financial stability of Kenya. There is a permanent positive response of financial stability to shocks in capital adequacy ratio. The result of minimum liquidity requirement ratio is statistically significant, but the sign is unexpected. A shock to liquidity requirement ratio has a negative effect on the financial stability. Bank supervisory guidance has no statistically significant effect on the financial stability of Kenya, likely due to the implementation problems of this regulation in the country. The variance decomposition result confirms the result of the impulse response function about the effectiveness of financial regulation variables on the financial stability of Kenya. Capital regulation shock explains 42.90% of the fluctuations of financial stability and the shock to liquidity requirement ratio explains 25.85%. Major challenges of Basel implementation in Kenya are lack of reliable data and information, development of the sound risk-management system, asymmetry in supervision, operational cost, access to finance, and market imperfection. Therefore, there is a need to hire highly qualified, responsible, transparent, and independent supervisors for the successful implementation of Basel Accords as the result supports that financial regulations have a significant effect on the financial stability of Kenya.

Keywords:

Financial stability, financial regulation, Kenya, Structural Vector Autoregressive

1. INTRODUCTION

A stable and efficient financial system plays an important role in economic development by providing resources to the real economy and facilitate economic growth through the efficient allocation of savings to the most profitable investment opportunities. It also has an important function in diversifying, pooling, and shifting risks to those agents who are ready to bear it (Prochniak and Wasiak, 2016). In addition, a sound financial system will have sufficient capital to absorb losses and sufficient liquidity to manage operations and volatility (Ruiz and Bruhn, 2019). On contrary, inefficient and weak financial systems are vulnerable to contagion, less capable of overcoming exchange market pressures and volatile capital flows, and more likely to aggravate and magnify the impacts of financial crises and other economic shocks (Khan and Khan, 2007).

This recognition has forced regulators, bankers, and other market participants to have a primary objective of maintaining financial stability in global banking and financial markets (Alici and Ozgoker, 2006). This is because financial stability is the joint stability of financial institutions and financial markets that are the two key components of the financial system. Financial stability is not only avoiding financial crises and managing systemic financial risk, but also the risk that triggers a loss of economic value or confidence in the financial system (Mariana and Donath, 2008). Therefore, financial stability is a vital prerequisite not only for monetary stability but also for the better development of the economy (Githinj, 2016).

On the other hand, financial crises have a negative impact on output and employment. For instance, in the 2007-09 global financial crises a minimum of double-digit fall has been observed in output of European economy. The average fall of real GDP from peak to trough by 9% is the testimony for the sizeable loss of output due to financial crises. The negative consequence of crises on output leads to a deterioration of the labor market that raised the rate of unemployment approximately by 7% during the same downturn (European Commission, 2009). Financial crises also lead to a recession that has a direct

result on employment. Skills are lost and unemployed youths become less productive over time because they missed a chance of learning by doing. The consequence of unemployment has a long-lasting negative effect on productivity and thus on long-run economic growth. Besides, financial instability results in welfare reduction and be a heavy burden on the economy since fluctuations of price variables in the financial market, amplify economic risks and bankruptcy of financial institutions or corporations (Schinasi, 2004).

Therefore, regulations and supervisions are vital to build a safer financial system and ensure its resilience to financial crises and economic recessions (Peterson, 2019). The main goal of these financial regulations is to keep the financial systems, financial institutions, and financial markets, safe and sound (Brownbridge and Kirkpatrick, 2010). There are two arguments on the effect of financial regulation on financial stability. The first view is on the importance of strict financial regulation on financial markets and financial institutions. The proponents stressed financial stability will be promoted due to tighter financial regulations. Any level of financial distress will be addressed with the formation of stable buffers is the view under this category. On the other hand, others argued that strict financial regulation is the one that creates instability of the financial system that may have an adverse effect on the real sector of the economy (Shaddady and Moore, 2019).

Moreover, Policy makers need to think beyond financial regulations of capital requirements and liquidity requirements to deal with financial instabilities (Kiemo et al, 2019). It is also essential to study the sources of financial instability as it results from different phenomena. Even if the sources come in many different forms, they have common elements. One or more of the following are the associated causes of financial crises. Credit volume and asset price change; extreme disorder of financial intermediaries, and the provision of external funds to different players of the economy; balance sheet problems of economic and financial agents (of firms, households, financial

intermediaries, and sovereigns); capital and liquidity support by the government. It is very difficult to measure the financial crises with a single indicator because of its multidimensional behavior (Claessens et al, 2013).

Financial instabilities can exist due to a sharp increase in asset prices. Theories suggested that the possible reasons for the deviation of asset prices from fundamentals could be information variations, disagreement among investors in the valuation of assets, sales barriers, and other limits of arbitrage. Another common factor that creates financial instability is a rapid increase in credit. Various factors triggered credit risks including structural changes in markets such as poorly designed financial liberalizations and innovations and shocks. The result of credit risk is a fall in profit and investment. This deterioration in profit and investment leads to the inability of firms to the repayment of their debt. This results financial system fragility that transmitted to banks as a form of a bank loan default (Glossop, 2011).

This leads to the establishment of the Basel committee for mitigating the risk of financial contagion that had spread with the growth of cross-border banking to address regulatory arbitrage by large internationally active banks. These internationally active banks were regulated by a series of prudential bank standards that were formulated by the Basel committee (Jones and Knaack, 2019). Even if the vast majority of developing countries are not members of the Basel committee, many of them have adopted global banking standards, from Basel I up to Basel III. It is also adopted in Kenya, international financial regulations and market liberalizations has been taken place in the country since 1995. Therefore, this project briefly discusses the Basel measures and their effectiveness as well as implementation challenges in Kenya. Related literatures and financial stability reports of Central Bank of Kenya is reviewed to get enough input for addressing this topic.

The main objective of this project is to examine the effect of financial regulations on the financial stability of Kenya. In order to achieve this objective, time-series data ranging

from 1995 to 2019 is used for analysis purposes. Studies on the same topic conducted by (Alici and Ozgoker, 2006) and (Mwega, 2014) in Turkey and in Kenya respectively, used descriptive statistics for measuring the effectiveness of financial regulations for safeguarding financial stability. This study examines the effect of financial regulation on the financial stability of Kenya by applying the Structural Vector Autoregressive model besides to the descriptive statistics. Empirical methodology helps to explain the magnitude of the response of financial stability for the impulses of financial regulation variables.

In addition to the methodology gap, this project fills the time gap of previous studies by providing the updated information on the evolution and trends of financial stability of Kenya as the latest paper conducted in the case of Kenya is in 2014. The trend analysis is conducted to see the basic characteristics of financial system of Kenya and comparison with low-middle income countries is made as it helps to measure the country's performance of financial system. In addition, the previous study in the case of Kenya by Mwega (2014) assessed only the implementation of internal financial regulations, whereas this paper examines both the international and internal financial regulations implemented in the case study under consideration.

The basic questions of the project are: What can we say about the performance of financial system in Kenya? Do the implemented financial regulations and Basel Accords are effective in strengthening the financial stability of Kenya? In addition, what are the implementation challenges of the Basel Accord in Kenya?

The project is organized under six sections. The first section includes an introduction of the project, project objectives, motivation, and an outline of the project report. The second section of this project reviews theoretical background and literature review. The third section of this project is devoted to an overview of the financial system in Kenya and trend analysis of variables. In the fourth section of the project, the empirical methodology of the study is presented. The fifth section deals with the results and discussion. Lastly, section six presents conclusions and policy implications.

2. THEORETICAL BACKGROUND AND LITERATURE REVIEW

This section reviews both the theoretical background and empirical literatures related to financial regulation and financial stability that supports the present study. Under theoretical background, theoretical reviews on financial regulation and financial stability are reviewed. While under empirical literature empirical studies on the nexus between financial regulation and financial stability are briefly discussed.

2.1 THEORETICAL BACKGROUND

2.1.1 Concepts and definitions

Definition of Financial System

The financial system is a way of wealth accumulation, the transformation of that wealth to the future, to finance feasible investment projects, and to manage risk by the economic agents of this country or region (Schmidt et al, 2006). Studies conducted in recent years suggested that financial development helps to minimize economic volatility as a whole. Economic fluctuation results in an increase in the number of poor people. Therefore, the financial system is used as an important insurance weapon for poor and near-poor society. The risk- reduction ability of the financial system is working if there are also supporting financial institutions that provide prudent risk-taking incentives. Otherwise, financial systems and their development can lead to amplification of risk than to its mitigation (Ruiz and Bruhn, 2019).

Definition of Financial Stability

It will be challenging to define and give exact meaning for financial stability because the term has no widely accepted definition. Different academicians, central banks, and policymakers give their own explanations for financial stability. The proponents of two schools of thought who studied the concept of financial stability followed two approaches for defining the issue. The first school of thought preferred the approach of defining

financial instability, while the other group makes an effort to define financial stability (Anatolevna, and Remilevna, 2013).

The first school of thought for the definition of financial stability is given by Mishkin (1999). He preferred to define financial instability rather than defining financial stability. Financial instability that occurs from vulnerable financial systems to shocks that occur when the system intervenes with information flows. So that the financial system will be unable to perform its channeling of funds from savers to the most productive opportunities of investment. The severe case of financial instability is the breakdown of almost all systems of finance in the financial market. The inability of financial intermediaries to produce information and channel funds to productive investment declines the overall economic activity.

Crockett (1997), who defined financial stability from the application of both institutions and markets, represented the second school of thought. Financial stability is a situation that determines the ability of financial systems to resist shocks without allowing ways to cumulative process, that impair the transformation of accumulated saving to the most efficient investment opportunities. Key institutions of the financial system need to be stable for achieving overall financial stability in the economy. The result will be fruit full as it guarantees a higher degree of confidence to participants of the system in order to meet their contractual obligations without third-party guidance and intervention. In addition, financial stability needs the stability of key markets. In the stable financial market, participants can confidently transact with the price that reflects fundamental forces and that does not change every time without substantial change in the fundamentals.

Schinasi (2004) suggested five basic principles that should be considered when we define financial stability. First, the topic of financial stability denotes a large idea, containing different features of the financial system as infrastructure, institutions, and markets. Second, financial stability includes a suitable operation for the system of payment, in addition to saving mobilization, risk management, and efficiency in resource allocation,

and assistance of welfare maximization. Third, it is not correct to link financial stability only with the absence of financial crises, but also with the ability of the system to limit the imbalances and the contagion phenomenon. Fourth, financial stability has to be structured depending on its impact and its consequence on the real economy. Fifth, the analysis of financial stability can be made when it stands for a continuous phenomenon.

The main sources of risks might be either endogenous or exogenous sources are very important for financial decisions and policies which can be implemented to use them. If the risk arises from financial institutions, financial markets, and infrastructure, it is said to be the endogenous source.

Sources of risks from financial institutions

Financial institutions are the ones to be a source for risks and vulnerabilities. Risks may affect several institutions that have identical exposures or the shock may initially arise from one single institution and spread over other parts of the financial system. Sources like credit, liquidity, interest rate, market and currency are among the examples (see table 2.1 below for the details). The process of intermediating funds from savers to investors by financial institutions will be limited if credit risks, market risks, liquidity risks, interest rate risks, and foreign currency exposures are exist. The vulnerability of financial institutions for legal, operational, and reputation risk leads to an adverse effect on the development of sectors. The sensitivity of financial institutions on business strategies and a concentration of exposures fall capital that in turn decreases the absorption capacity of institutions (Glossop,2011).

Sources of risks from financial markets

Changes in market prices, especially in interest rate and foreign exchange rates is the second sources of risks from markets because they provide alternative means of finance for non-financial sectors. Besides, financial markets systematically link financial institutions and they are a place to directly link savers and investors. As it is indicated in the summary table 2.1 below, counter-party risk and asset-price misalignment are the

best examples of market risks. Financial markets are also exposed to Runs and contagion. Asset price volatility is one important form of volatility (Wyplosz, 1998).

Sources of risks from infrastructure

Endogenous sources of risk might be through infrastructure, which is an important source of risk. Infrastructures link participants in the market and facilitate the operation of financial institutions and the market. Institutional vulnerabilities originate from financial system participants in a time of payment system, risks in financial institutions arise in relation to clearing and settlement. Some of the examples of infrastructural risks are a failure in operation, risks of concentration and domino effects, and weakness in the legal system and accounting system (Wolfson, 1999).

Sources of risks might be exogenous, such types of sources for risk are risks originated from outside of the financial system. Sudden introduction or withdrawal of trade restrictions, political instabilities, and natural disasters are among the examples of exogenous sources of risks. Vulnerabilities may arise at the macroeconomic level or microeconomic level. Macro-economic policy imbalances, technological innovations, and oil price shocks are sources of macroeconomic risks. Exogenous vulnerabilities raised from macroeconomic shocks affect financial stability because the imbalance can pose risks on the economy and on the financial actors. On the other hand, stable and well-performing macroeconomics is vital for maintaining financial stability and for achieving the financial obligations of financial actors like government, households, and companies. Moreover, there are microeconomic situations that undermine the confidence of markets and creates imbalances overall financial system such as failures in large companies (Schinasi, 2005).

Table 2. 1: Summary of sources of risk for financial stability

Endogenous Sources	*Exogenous Sources*
Institutions based • Financial risks Credit Market Liquidity Interest rate Currency • Operational risk • Information technology weaknesses • Legal or integrity risk • Reputation risk • Business strategy risk • Concentration risk • Capital adequacy risk **Market based** • Counterparty risk • Asset price misalignment • Run on markets Credit Liquidity • Contagion **Infrastructure based** • Clearance, payment, and settlement system risk • Infrastructure fragilities Legal Regulatory Accounting Supervisory • Collapse of confidence leading to runs • Domino effects	**Macroeconomic disturbances** • Economic environment risk • Policy imbalances **Event risk** • Natural disaster • Political events • Large business failures

Source: (Schinasi ,2005)

Definition of Financial Regulation

Financial regulations are governing laws that guide banks, investment firms, and insurance companies, which mainly designed to safeguard participants of the financial system from financial risk and fraud. The two main reasons for the implementation of financial regulations are to increase the information availability of investors and to guarantee the soundness of the financial system (Shaddady and Moore, 2019).

Types of financial regulations:

There are six types of financial regulations. Macroeconomic, allocative, structural, prudential, organizational, and protective. Each regulation has its own objective and key policy instruments, which is presented in table 2.2.

A centralized body for reducing risks in the bank mainly executes global banking regulation known as Basel Accord. It is mainly systematic risk reduction. This is to avoid mis-uses from banks, to maintain the confidentiality of banks and to create credit allocation.

Table 2.2: Types of financial regulations and their objectives

Ser. No.	Types of regulation	Objectives	Key policy instruments
1.	**Macroeconomic**	-To maintain control over aggregate economic activity - To maintain internal and external balance	Reserve requirement, direct credit and deposit ceilings, interest rate controls, restrictions on foreign capital
2.	**Allocative**	-To influence the allocation of financial resources in favor of priority activities.	Selective credit allocation, Compulsory investment requirements, preferential interest rates.
3.	**Structural**	-To control the action of dominant firms that exercise possible abuse of monopoly power	Restrictions in function and geography. Controls like merger and entry.
4.	**Prudential**	- To maintain the confidence of the public in systemic stability and prevent the soundness and safety of individual financial institutions.	Authorization criteria, minimum requirements of capital, limits on the concentration of risks, reporting requirements.
5.	**Organizational**	-To ensure smooth functioning and integrity of financial markets and information exchanges.	Disclosure of market information, minimum technical standards, rule of market making and participation.
6.	**Protective**	-To provide protection to users of financial services, especially consumers and nonprofessional investors.	Information disclosure to consumers, compensation funds, ombudsmen to investigate and resolve disputes.

Source: (Khan and Khan, 2007)

2.1.2 Basel Accord

Governors of the central bank from the group of 10 countries formed the Basel Committee of banking regulations and supervisory practices at the end of 1974. Regular meetings have been held since the first meeting took place in February 1975. Central bank representatives from member countries of G10 have formal responsibility for bank supervision.

The first announcement on the international bank's settlement is formulated in 1988 by the Basel Committee on Banking supervision (BCBS). The calculation of capital that commercial banks have to hold in order to defend themselves from credit risk is mainly stressed by Basel I. Amendments were made on the Basel accord since the establishment of the committee. The first amendment takes place in 1996, this amendment is the first to introduce bankbooks. It states the importance of the separation of bankbook and trading book. Banks have to prepare their separate books with the principle of each book contains different elements. Bank booking contains loans, personal accounts, and other industrials. Whereas the trading book contains the daily-revalued instruments of derivatives like swap and options, bonds, and stocks (Omondi, 2015).

The amendment calculates capital buffer for the trading book using the Value at Risk (VaR) calculation measure. The method of this calculation takes N=10 and X=99. It can be interpreted as over a 10-day period revaluation, only 1% is expected to be exceeded. After calculating their VaR, banks will make the reporting statement "The loss of our bank will not be more than V dollars for the coming days, we are X% certain of that" (Ibid).

Basel Accords are the most influential and misunderstood agreements in modern international finance. Accords give harmonized regulations, banking supervisions and capital adequacy standards all over the world. However, any misunderstanding of the accord leads to misinterpretation and misuse of those regulations and supervisions causing political consequences in the economy (Martha, 2009).

Basel I has only one pillar that is minimum capital requirements. This requirement is suggested for all internationally active banks and other non-member banks of the Basel committee, but want to be strict in their banking regulations.

The establishment of Basel II in 2004 brought a new intuition on the protection of bank failures. Around 100 countries that already adopted Basel I accord started the implementation of Basel II in 2007. This standard banking regulation restricted the minimum capital required for bank management from losses. The Basel II announced the strongest bank risk management suggestion of risks raised from the credit, market, and operational risks (Mewngi, 2009).

Credit risk exists when borrowers fail to refund their borrowings, the market risk is volatility in banks portfolio due to change market factors and operational risks is a source of risk resulted from banks inefficient internal process system, people or external events like natural disasters and robbery (Herring, 1999).

Basel II has three pillars for safeguarding internationally active banks from the aforementioned risks. The pillars are namely Pillar I minimum capital requirement, pillar II, bank supervision, and pillar III, market discipline. The three pillars are the basis for Basel II to maintain financial stability. For capital to risk-weighted assets, banks have to have greater than 8% for fulfilling the first pillar of Basel II. Basel II has two measures of risks associated with regulatory capital. These are standard approach and internal ratings-based approach. In order to measure the risks of banks' assets, banks may use either a standard approach given by the Basel committee or use their own internal ratings (Martha, 2009). The regulatory capital is amended based on Basel I. The bank's profile on risk assets is studied to decide on the allocation of minimum capital requirements. 9% is a minimum capital adequacy ratio that all banks should have to hold. In order to implement Basel II, banks need to get greater than 20% of share abroad (Mewngi, 2014).

It has been particularly observed that far-reaching efforts on reform for extensive modifications in international banking regulations (Jones and Knaack, 2019). Besides, the

financial reform has a significant improvement in the solvency and liquidity requirements of banks in the global system. The member countries of the G20 reacted to the global financial crises with a new agenda for regulating banks, this framework is commonly known as Basel III. This Basel III promotes both the quality and quantity of banking capital, announces two liquidity and one leverage ratio (Co-Pierre, 2011).

Table 2.3: Short summary of Basel regulations

Basel Accord	Year	Regulation	Objectives
Basel I	1988	Asses bank capital adequacy requirements Advocate Risk-based supervision (RWA) Set of minimum capital requirements for banks to address banks credit risk	Strength the soundness and stability of international banks Reduce competitive inequality among them
Basel II	2004 Implemented from 2007	Mandatory requirement of more capital on hand for banks holding riskier asset Mandatory disclosure of risky investments and risky management practices International convergence of capital measurement and capital standard	Increase in quality and stability of international banks Maintaining the level playing ground for active banks Promotion of the adoption of stringent practices in risk management
Basel III	2010	Capital conservation buffer Countercyclical buffer Leverage ratio Liquidity ratio (Liquidity Coverage Ratio & Net Stable Funding Ratio)	Improve banks' ability to deal with financial stress Improve risk management Strength banks transparency Foster resilience to reduce risk of system-wide shocks

Source: Own summary

2.1.3 Basel implementation in Kenya

The focus of Basel I in 1988 was capital adequacy and credit risk. The implementation of Basel I in Kenya has taken place in the year 1994. The requirements of the minimum capital adequacy ratios are 8 %. This is as a minimum weighted risk of capital adequacy ratio. In 1996, the Central Bank of Kenya amends the limit of borrowers to core capital ratio from 100 % to 25%. The adoption of this regulation has mainly the objective of reduction in the burden of a single borrower, as the previously applied rate was (100%) and results in loan default. Minimum capital requirements of banks were regulated according to the recommendation of Basel I and the requirement increased from Kenya shilling of 200 million to 250 million. In 1997, the structural transformation has taken place in the Central Bank of Kenya for reducing political intervention by higher officials of the countries ministry of finance. The power of appointing Central Bank directors transferred to the President from the ministry of finance. This is because the direct appointment of directors was the responsibility of the finance minister that was vulnerable to political interference and corruption. Following the failures of many banks in 1998, banks were requested to disclose their detailed report on provision for non-performing loans and to realese a published report of their account to the public since 1999 (Radha, 2017).

Table 2. 4: Summary of capital requirement regulations in Kenya

Year	Regulation	Minimum requirement	
1994	Core capital to total risk weighted asset ratio	8%	
1996	Total capital to total risk weighted assets ratio	12%	
2000	Core capital to total deposit ratio	8%	
2012	Core capital	1 billion Kenya Shelling ($12 million)	
2013	Capital conservation buffer	2.5%	Core capital to total risk weighted assets ratio: 10.5%
			Total capital to risk weighted assets ratio: 14.5%

Source: (Gudmundsson et al, 2013)

Although Basel II is introduced in 2004, the Central Bank of Kenya adopted it in 2005. It took 3 years to assess the status of banks in Kenya and to make a discussion on the implementation procedures of the regulation with stakeholders. In 2008, the minimum capital requirement was proposed and the bank supervisory guidance framework was introduced. Implementation of Basel II is not mandatory for non-member countries of the Basel committee. This is because the implementation required full adoption of Basel I of credit risk (Omondi, 2015).

The full implementation of Basel II is started in Kenya since the year of 2013. The three pillars implemented accordingly by the country's banks. The third pillar implemented in 2006. Banks started quarterly disclosure of their financial statement starting from this year. In addition, the Central bank of Kenya implemented pillar I of Basel II recommendation on capital adequacy requirements since 2013. Pillar three of Basel II implemented in 2015, this pillar is about bank supervisory guidance (CBK, 2020).

The 2007/09 financial crisis resulted from the collapse of the Lehman brothers in 2008. The main pushing factor for the establishment of the new Basel regulation (Basel III) is the collapse of banks after the global financial crisis. Kenya adopted the liquidity measurement standard and capital conservation buffers of 2.5 % since 2013. Therefore, the core capital to total risk weighted asset ratio became 10.5% and total capital to risk weighted assets ratio became 14.5 % (Radha, 2017).

The major financial regulation variables of this paper are developed from the three Basel implementations in the case study under consideration. These variables are the Capital adequacy ratio that measures the overall capital regulations, bank supervisory guidance measured by the supervisory quality index of Kenya, and liquidity coverage ratio.

2.1.4 Basel implementation challenges in Kenya

Jones and Knaack (2019), observed five challenges of Basel implementation in LICs and LMICs.

The first obstacle that faces these countries is the gap in infrastructural facilities that are directly related to financial development. The Basel II and Basel III standards required financial system developments, well-organized and deeply performing stock markets for its implementation. However, these requirements are not available or are limited in number, or are not sufficient to meet Basel requirements.

The second challenge is that most of the regulations and minimum requirements are less relevant for LMICs. Fluctuations in the financial systems are less observable in LMICs as the systems are not well-functioning. The third obstacle is scarce resources in developing countries for timely implementation of bank supervisory guidance. Bank supervision and public disclosure of banks financial report needs advanced information technologies and new training and hiring of new staffs. This increases the costs of the banking sector and may discourage adopting the regulation.

The fourth constraint is a human resource and exacerbated information asymmetry between supervisors and banks. Highly qualified supervisors are required to predict credit risks that challenge LMICs to find motivated and strong supervisors to meet the risk management system. Lastly, banks that already implement Basel II and III faces deterioration of credit composition. The regulations forced to banks to shift their portfolio that may negatively affect the financial inclusion of the economy.

Mewngi (2014) stated that the Basel implementation challenges in Kenya are lack of reliable data and information, development of the sound risk-management system, asymmetry in supervision, operational cost, access to finance, and market imperfection. As indicated by Kombo and Njuguna (2017), the main challenges for Kenyan commercial banks for the implementation of Basel III are, lack of adequate staffs on CBK, lack of adequate systems for supervision on the implementation of new regulations, limitations on regulation, risks on additional capital and finance management culture, and other growth barriers. According to Radha (2017), Most of the recommendations of Basel III are not implemented by Kenya. To mention them: Contingency capital ratios, net stable funding ratio, and guidelines on systematically important banks. He suggested that the non-conducive financial system environment is a challenge for accurate measure and adequate supervision of banking systems in Kenya especially to control market risk.

2.2 EMPERICAL LITERATURE REVIEW

Different studies have been conducted on financial regulation and financial stability in developing countries. Alici and Ozgoker (2006) studied the power of financial regulation adopted by Turkey for strengthening financial stability throughout the liberalization process. Researchers assessed the effect of minimum capital requirements and liquidity requirements of Basel committee recommendations in Turkey. Mwega (2014) conducted a study on financial regulation and financial stability in Kenya, the study focused also on balancing inclusive growth. The study investigated the relationship between financial regulation and financial stability in Kenya's financial market with their potential

contribution to inclusive growth. The paper analyzed the internal financial regulations and their merits and demerits of these regulations for maintaining financial stability in Kenya.

Both studies mentioned above used descriptive statistics for measuring the effectiveness of financial regulations for safeguarding financial stability in Turkey and in Kenya. This study examines the effect of financial regulation on the financial stability of Kenya by Applying the Structural Vector Autoregressive model. A quarterly time-series data ranging from 1995 Q1 to 2019 Q4 is considered for analysis purposes.

Shaddady and Moore (2019) used CAMEL- DEA quantile regression for investigating the effects of financial regulation and supervision on bank stability. The study was conducted on 47 countries by using unbalanced panel data of 2210 banks. The data collected ranges from 2000-2016. The explained variable of this model was bank stability and proxies by CAMELS. Capital adequacy, Asset quality, Management efficiency, Earning quality, Liquidity, and Sensitivity to market risk are the variables used in the study to measure financial stability. The independent variables are, core profitability model, capital regulation index, activity restrictions, deposit insurance, private monitoring index, official supervisory power, government owned banks, business freedom index and macro-economic variables of GDP and inflation. Main variables like capital adequacy ratio, bank supervisor index, and Liquidity coverage ratio of the current study adopted from this research.

Table 2.5: Summary of related studies on the financial regulation and financial stability

Name of researcher/es and year	Country	Applied methodology	Result
Alici and Ozgoker, (2006)	Turkey	Descriptive statistics to assess the Basel recommendations of liquidity and capital requirements in turkey.	The results of implemented financial regulations and liberalization process failed to achieve the intention of policies. Very limited usefulness of those policies to control risks in the financial system.
Mwega (2014)	Kenya	Case study to investigate the tradeoff between financial regulation and financial stability of financial sectors in Kenya.	The countries Central Banks mainly focuses on micro prudential regulations and less on macro prudential regulations, which shows the financial stability of the financial system as a whole. Kenya regulates banks mainly based on accords of Basel I and Basel II. The new implementation of Basel III is introduced to sectors in January 2013.
Shaddady and Moore (2019)	Across 47 countries	Panel data of 2210 banks ranging from 2000-2016. CAMELS rating system is applied to quantile regressions.	Greater capital regulation affects financial stability positively. Adverse effects on banks stability is occurred due to tighter restrictions, deposit insurance, and excess of supervision.

Having been motivated from the work of previous studies on the financial regulation and financial stability, this paper tries to fill gaps on the existing literature, time and methodology. The study conducted by Mweng (2014) is in the same case area of this

project. This paper provides the latest information on the trends of financial stability of Kenya as the study with a similar topic in Kenya is conducted in 2014. In addition, this project examines areas that were not touched by the previous paper in Kenya. The previous study in the case of Kenya by Mwega (2014) assessed only internal financial regulations. Whereas this paper examine both the international and internal financial regulations. The project briefly discuss the Basel measures and their effectiveness as well as implementation challenges in Kenya. This study used Structural Vector Autoregressive approach to evaluate the effectiveness of implemented financial regulation on the financial stability of Kenya for the years ranging from 1995:1 to 2019:4.

3. OVERVIEW OF FINANCIAL SYSTEM IN KENYA

This section briefly describes the study area, the performance of financial system using the basic characteristics like financial depth, access and efficiency and the trend analysis for the major financial variables of the analysis.

3.1 Description of the study area

Kenya is an East African country with a total area coverage of 580, 367 square kilometers, and a total population of around 54 million, as it was reported by the UN (2020). The country's GDP was 101,048 billion dollars in 2020. Major economic activities in Kenya can be categorized under agriculture, manufacturing, and service sectors that make the country's economy the third-largest economy in Sub-Saharan African countries after Nigeria and South Africa.

The financial system in Kenya is lightly regulated and there is a relatively open capital account (Mwega, 2014). There are more than 14 foreign banks, dynamic stock exchange, derivatives, and security exchange markets that resulted from the conducive environment of the financial system in Kenya (Gottschalk, 2015). In the work by Brownbridge and Kirkpatrick (2010), classification of sub-Saharan African countries was made having yardstick criteria of the status of bank supervision. The researchers suggested that bank supervision in Kenya is well-designed and effectively implemented. The central bank of Kenya regulates banks of the country using Basel Accords mainly for guaranteeing financial stability in the country (Githinj, 2016). Central Bank of Kenya (CBK) is an independent institution that is free from any influence and intervention for exercising its power and it is not directed or controlled by any person or authority (Radha,2017).

3.2 Characteristics of financial system in Kenya

In the work of Chiak et al (2012), four features of measuring financial institutions and financial markets are given. These four characteristics are proxies for the services

rendered by actors in the financial system. The first feature is the size of financial institutions and financial markets (financial depth). Access to financial institutions and financial markets is the second characteristics that measures the extent of the use of financial institutions and markets by citizens. Thirdly, the efficiency of the provision of services on the financial institutions and financial markets. The last characteristics is Stability. In this section, financial depth, access and efficiency of financial institutions and financial markets in Kenya are assessed as they measure the status of financial system development for a given country. Showing the trend of financial stability indicators is one objective of this study that is presented in the next subsection.

Indicators to capture depth, access, efficiency and stability are different for financial institutions and financial markets. This difference is illustrated in Table 3.1 below that presents the indicators selected for the evaluation (Čihák, et al, 2012; Setiawan, 2015).

Table 3.1: Variables for measuring depth , access, efficiency and stability

	FINANCIAL INSTITUTIONS	**FINANCIAL MARKETS**
DEPTH	-Private credit by deposit money banks to GDP (%)	-Stock Market capitalization to GDP
ACCESS	-Accounts per 1000 Adults. -Bank Branches per 100,000 adults. -ATMS per 100,000 adults.	
EFFICIENCY	-Net interest margin	-Turnover ratio
STABILITY	-z-score (distance to default)	-Stock Price volatility

Source: WB, GFDD database

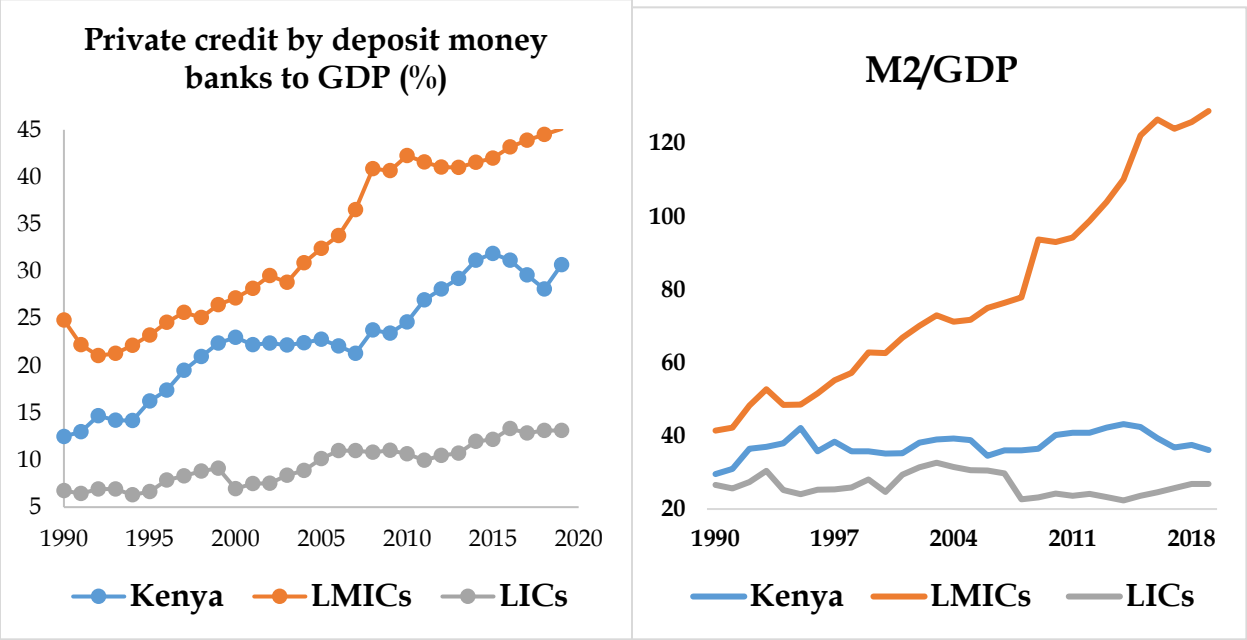
3.2.1 Financial depth

Important indicators of depth in the case of financial institutions and financial markets are assessed for evaluating the financial system performance of Kenya.

Private credit by deposit money banks to GDP (%) and M2/GDP

These indicators used to measure the size of financial institutions in Kenya. Private credit by deposit money banks to GDP (%) measures the provision of financial resources by domestic money banks specifically to the private sector as a percentage share of GDP. Commercial banks and other financial institutions are among the components of domestic money banks that accept transfer deposits such as demand deposits. Kamba (2010) used broad Money (M2) to GDP ratio for measuring the financial sector performance and depth of countries. The paper also mentioned that M2/GDP is the first and commonly used ratio that measures financial development. This indicator measured the profitability and size of the banking sector.

Figure 3.1: Trends of private credit to GDP (%) and M2/GDP



Source: WB, GFDD database

Private credit by deposit money banks to GDP (%) in Kenya is below the average of Low-Middle Income countries (LMICs) and above Low-Income countries (LICs) throughout the period under consideration. This indicator shows an increasing trend from 1994 to 1999. In the year 1997, the value of this indicator in Kenya was around 19.51%, which is

below the value of LMICs (25.63%) and more than a double of LICs (8.31%). From 2000 to 2008, the private credit to GDP ratio has a decreasing trend due to the surrounding uncertainty following the national election of the country in 2002. The world financial crises contributes to the lower value of this indicator in 2007, it was 21.3% and still lags behind the value of LMICs (36.54%) and beyond LICs (11%). The highest ratio of this indicator in Kenya is observed in 2015 (31.9%). In 2017, the average value for LMICs was 43.90%, 29.90% in Kenya and it was 12.86 % in LICs.

The broad money (M2) to GDP ratio of Kenya ranges from 29.58% to 43.25% for the study period under consideration. As it is indicated in figure 3.1, LMICs has continuously increasing trend of M2/GDP ratio after 2010. Where as in Kenya, it declines from 42.43 in 2015 to 36.18 in 2019. Therefore, it can be concluded that Kenya is far behind from the average of its income group implying that the financial sector is not developed in comparison to LMICs and well-developed in relative to LICs.

Stock market capitalization to GDP (%)

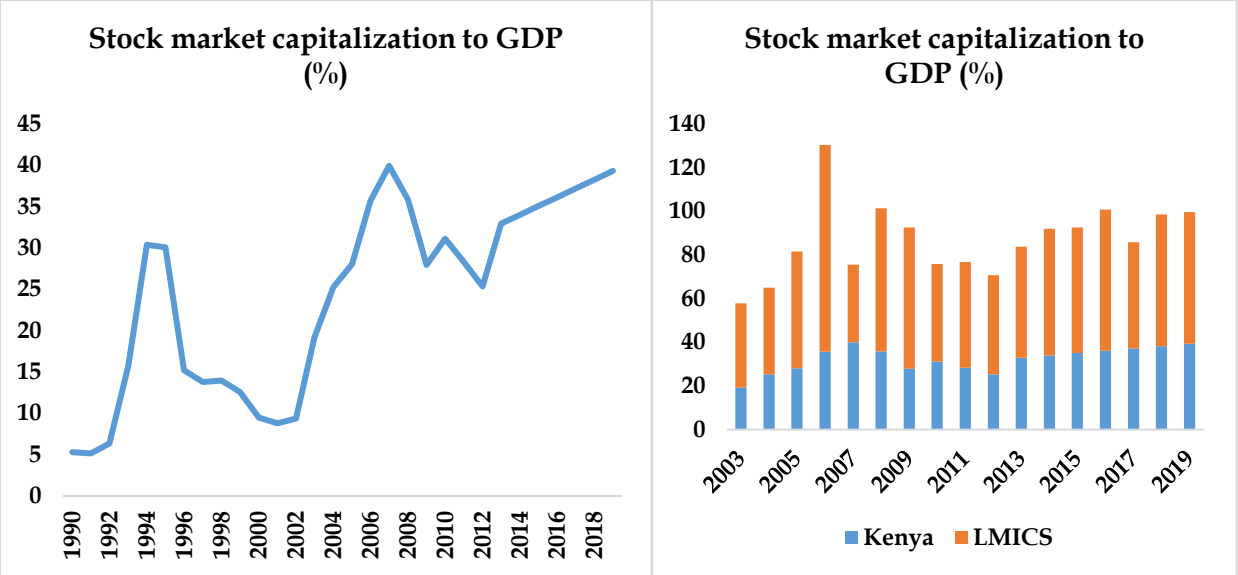
Financial markets have a role in promoting economic growth through intermediation, domestic saving mobilization, resource allocation, and fostering capital inflows. In addition, the role of the banking sector is supplemented by the stock market through the provision of liquidity, reduction of transaction costs, risk transfer, price discovery, and reduction of information cost. Nairobi Securities Exchange (NSE) is the stock market in Kenya, which is the most developed stock market in Eastern and Central African countries and young and developing in comparison to the international standards (Nyasha and Odhiambo, 2014).

Unlike the previous indicator, this indicator used to measure the financial depth of the financial market of Kenya. It is a value for all listed shares to GDP ratio, which shows the size of the stock markets relative to the economy (Beck and Levine, 2002).

Figure 3.2 reveals that the stock market capitalization to GDP ratio of Kenya has a fluctuating trend. It is continuously increasing from 1992 to 1994 and starts decline after

1995. The lowest values are registered in 1990 and 2001. Lack of transparency and accountability in bids, bureaucratic law and order qualities and corruption are possible reasons for the low performance during those years. After 2002 it continuously increasing and reaches, it's maximum in 2007. The increase in stock market liquidity, institutional quality after critical reform on the sector, and development of banking sector contributes to the improvement of this indicator. In addition, serious of incentives such as a favorable tax regimes were put in place to encourage investments in the NSE. The figure shows that this indicator has a positive increasing value after 2015. The value of Kenya's stock market capitalization to GDP ratio was 20% in 2003 and it was 38.7% for LMICs. For the year 2007, the value in LMICs was 34% and it is recorded as 40% in Kenya. In 2017, the average of LMICs is equal to the value of Kenya, which was 37%. It can be said that, Kenya has a promising performance in this indicator in comparison to LMICS.

Figure 3.2: Trends of stock market capitalization to GDP (%)



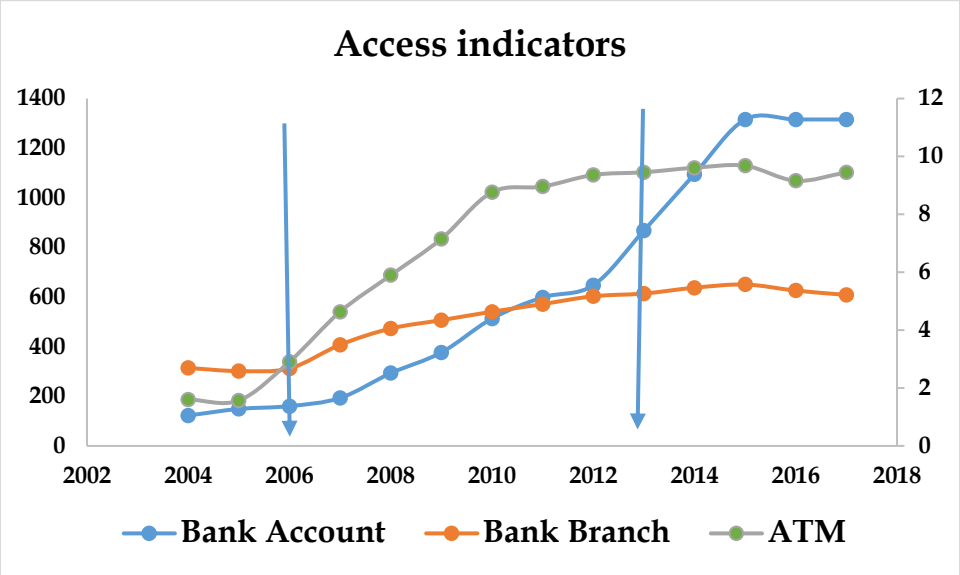
Source: WB, GFDD database

3.2.2 Financial access

One of the ambitions that have often motivated the creation of fashion financial systems has been to make financing easily accessible to all economic agents, including

households, businesses, entrepreneurs, and states. We can say that capital is the blood that circulates in the economy and smooths economic transactions. An operational and efficient financial system makes it possible to reduce market frictions by providing a range of useful services to its users. Therefore, access to financial services in an economy gives us a lot of information about its level of development.

Figure 3.3: Trends of access indicators



Source: WB, GFDD database

To measure the financial access of Kenya, indicators of financial institutions from 2004-2017 are used. The financial market data is not available in the source dataset. Indicators are specified with their first name in the figure 3.3. Bank account is measured with bank accounts per 1,000 Adults. Bank branch stands for bank branches per 100,000 adults and ATMs per 100,000 adults are represented by ATM. The two vertical lines are the Basel implementation years in Kenya.

The blue line is a representation of bank account per 1000 adults. In Kenya, the value for this indicator is continuously increasing. This increase is driven by per capita income and popularization of new information and communication technologies, in particular, telephone and Internet access. After 2013, the value of this indicator rises continuously

and the maximum number of bank accounts per 1000 adults is in 2017 with the value of 1315.63. The lowest record in Kenya is 2004 (122.694) and the reason is lack of financial literacy and the level of inequalities as Shawn et al. (2011) explain. Households with poor financial literacy tend not to open accounts and use informal means to borrow money or save.

The orange line in figure 3.3 represents bank branches per 100,000 adults for Kenya from 2004 to 2017. The trend shows that there is almost constant value in the opening of bank branches in Kenya from 2004 to 2017. (From 2 to 5.5). This result can be explained by the revival of e-Banking (FinTech, AssurTech) in recent years and the effects of Basel regulations on minimum capital requirements of banks to the banking sector.

ATM[1] per 100,000 adults is drawn with the green line in the figure 3.3. ATMs are increasingly widespread after 2006 and reach at its maximum in 2014 (around 10 ATM machines per 100,000 adults) in Kenya. ATM allows banks to make cash easily accessible to their customers. Banking sector restructuring explains the rise in the ATM service in Kenya, but the service is still lagging behind the average of LMICs (it was 16 in 2017).

3.2.3 Financial efficiency

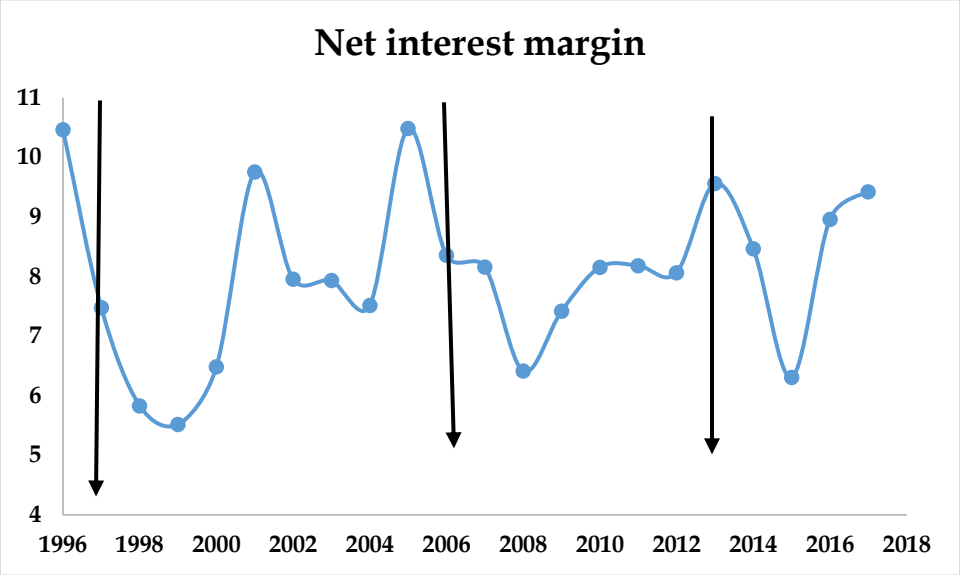
Efficiency of Banks and financial markets measures the performance of the financial systems. The efficiency of financial institutions resulted from reforms in the banking sector and strong regulations on financial frameworks. Technological advancement and adoption of information technologies in the provision of banking services play a great role in the promotion of financial institutions and market efficiency. Chiak et al (2012), indicate that the first indicators of financial efficiency are net interest margin for financial institutions and turnover ratio for financial market.

[1] Automated Teller Machine.

Net interest margin

A positive value of this indicator is an implication for the profitability of an institution and a negative result is an indication of loss or inefficiency of an investment. Net interest margin is calculated as the difference between net interest incomes of firms with the outgoing interest that the firm pays. The net interest is generated from loans and mortgages while the interest is paid or deposits and saving accounts. Transaction risks of banks contributed to the existence of net interest margin (Saksonova, 2014). This indicator is analyzed using data ranging from 1996 to 2017. The value of this indicator in Kenya is positive for the period of study under consideration. The vertical lines are drawn for observing the effect of Basel regulation in the country and the lines represent he Basel implementation years. There is an inverse relationship between a higher net interest margin and bank efficiency. The lowest margin is registered in 1998 (5.2%). The 2007/08 financial crisis influenced the net interest margin of Kenya as the value falls in 2008. In 2005, the net interest margin is registered to be 11% that reflects both default and interest rate premiums.

Figure 3.4: Trends of net interest margin

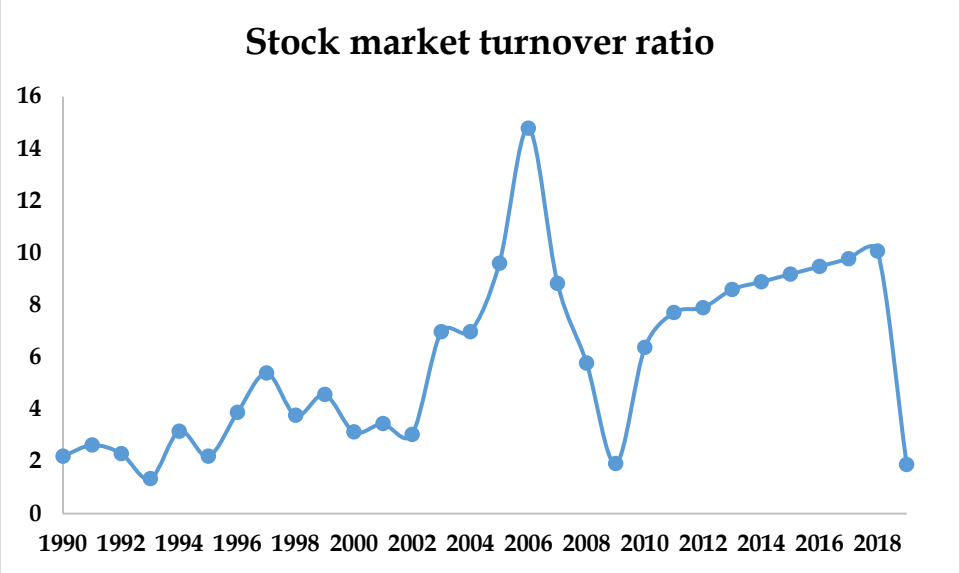


Source: WB, GFDD database

Stock market turnover ratio

This indicator is the first indicator that measures the efficiency of financial markets in Kenya. It is calculated as the ratio of the total traded value of domestic shares to the average stock market capitalization. The highest value is registered in 2006 and the value was 14.8. The lowest value is recorded in 1993 with the value of 1.34. Construction of modern information center, computerization and electronic trading enhances the growth and development of NSE contributes for the highest value. The market turnover ratio is highly volatile except for the years from 2012 to 2016. This indicates that the stock market in Kenya has a dynamic fluctuation and responsive to shocks in the determinants. The value falls from 8.8 in 2007 to 5.8 in 2008 due to the world financial crisis. After a permanent increase for the years ranging from 2012 to 2018, it falls to 1.88 in 2019 due to liquidity problem that causes investors to concentrate their funds only about half of the listed stocks.

Figure 3.5: Trends of stock market turnover ratio



Source: WB, GFDD database

The value of 2019 in Kenya was the lowest rate from LMICs. The average of LMICs in this indicator for the year 2019 was 14.96. The lowest stock market turnover ratio during this year is justified by the difficult business conditions that faced companies involved in the stock market industry due to Covid19 pandemic. This indicates that the financial market of the country is not efficient as it is experienced volatilities and lower rates of key indicators

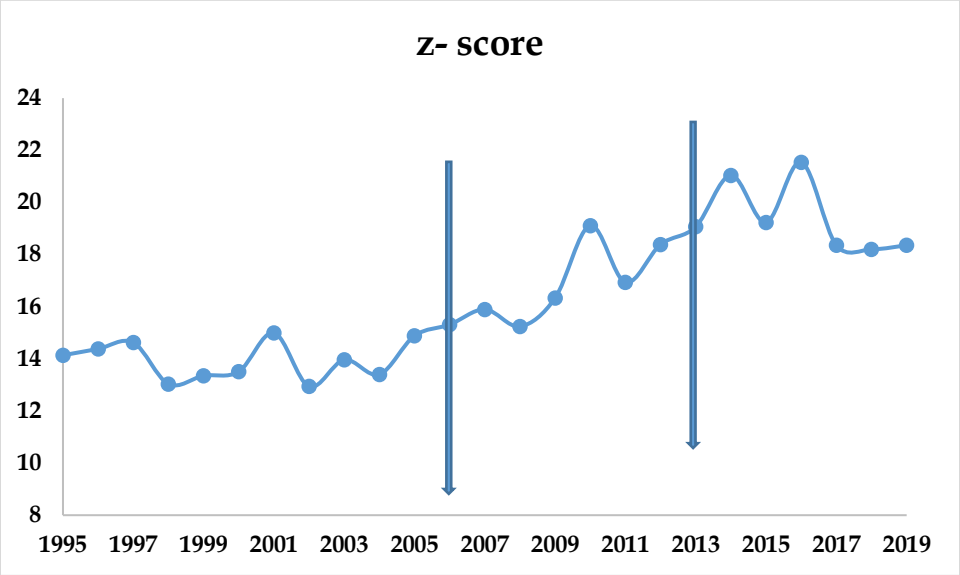
3.3 Trends of financial stability indicators

The resilience of the financial system to financial stress is financial stability. These variable proxies by the first indicator of financial stability given by Čihák, et al (2012), Z score (distance to default). It is a commonly used measure for financial stability and this sub-section is devoted to reporting the evolution of financial institutions of Kenya from 1995 to 2019. Z score is calculated as $(k+\mu)/\delta$, where k is equity capital to assets ratio, μ is the return on asset (ROA) and δ is the standard deviation of ROA (volatility of ROA). Z score measures the bank's distance from insolvency. In addition, it is an accounting measure of the distance to default (World Bank, 2020). As it is indicated by the above formula that the volatility is the denominator and the equity capital and ROA are the numerators, the higher value of the z-score shows the lower risk of banks and the lower score implies a higher risk of banks (Li et al, 2017).

The vertical lines in the figure 3.6 below shows years of Basel implementations in the case study. It is observed that there is a persistent positive value for z-score that is fluctuating from 13 to 22 for the study period under consideration. The figure revealed that the implementation of Basel Accord has positive effect on the financial stability of Kenya as there is a higher increment in the value of this indicator after the years of Basel implementation, 2006 and 2013. The sharp decline in 2008, 2010 is due to the global financial crises that results higher bankruptcies in commercial banks of the country and biggest rate of non-performing loan. According to the financial stability report of Central Bank of Kenya (2020**),** there was a stable and resilient financial sector in the country. The growth of total assets for the financial sectors grew by 9.9%. Liquidity improved to 53.3%

and it was calculated as the ratios of current assets to current liabilities. Profit of firms is promoted by 8.5 % in the year 2019. In the first half of the 2020, the growth of total asset was registered as 8.3 % whereas profitability has declined by around 25.6%, on the other hand, 56.5 % increment is registered from liquidity. Generally, the descriptive statistics reveals that financial stability variable has visible difference for the years' pre and post-Basel implementation. This result will be checked by using financial regulation variables in the econometrics analysis of the next section.

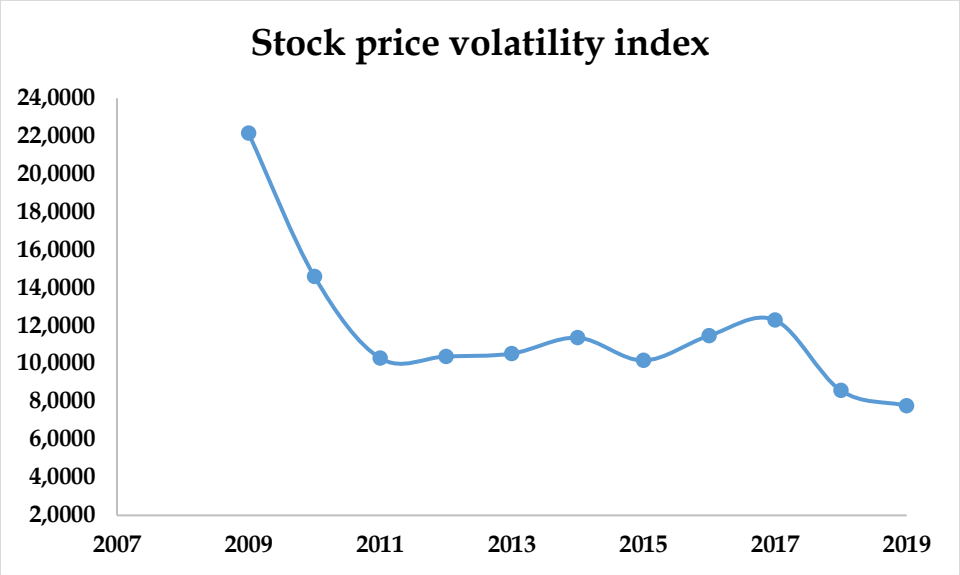
Figure 3.6: Trends of z-score



Source: WB, GFDD database

Stability of Kenya's financial markets measured by stock market volatility from 2009 to 2019. Stock price volatility is measured using only 11 years data due to lack of data availability. There is a sharp fall after the highest value was registered in 2009. The core reasons are the effect of financial crises that hatted the NSE and the domestic crises arose from the post-election violence brought along by political instability. After 2012, this indictor is registered as stable up to 2015 because the country formed Automated Trading System that facilitates transparency in price and volume movements of traded securities.

Figure 3.7: Trends of stock market volatility



Source: WB, GFDD database

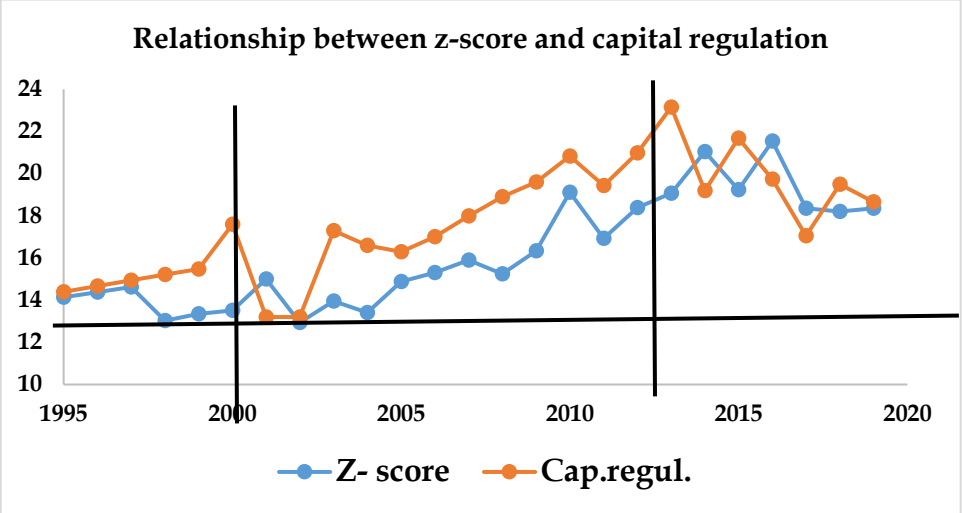
3.4 Relationship between financial stability and financial regulations in Kenya

Capital regulation variable

Banks' capital relative to risk-weighted assets ratio is represented by the horizontal line in the figure 3.8 below. It shows the minimum capital requirement that banks hold because it allows banks and financial institutions to have enough capital in order to resist operating losses. In addition, capital adequacy to risk-weighted asset ratio helps to promote financial stability and efficiency through financial systems. The horizontal black line in figure 3.8 below represents the minimum capital requirement of Basel regulation. The overall relationship between capital regulation and financial stability is indeterminate. For the years 1995, 2001-2003, the capital adequacy ratio was below the minimum requirement. For the remaining years, it is reported that the value is above the minimum requirement. From 2004-2013, capital regulation and financial stability go positively. After 2013, the two variables are highly volatile and negatively commove. In general, it can be said that for the majority of years in the observation, the two variables

have a positive relationship. This relationship will be checked by the econometrics analysis of the next section.

Figure 3.8: Relationship of financial stability and capital requirement regulation



Source: IMF and WB data

Liquidity requirement Variable

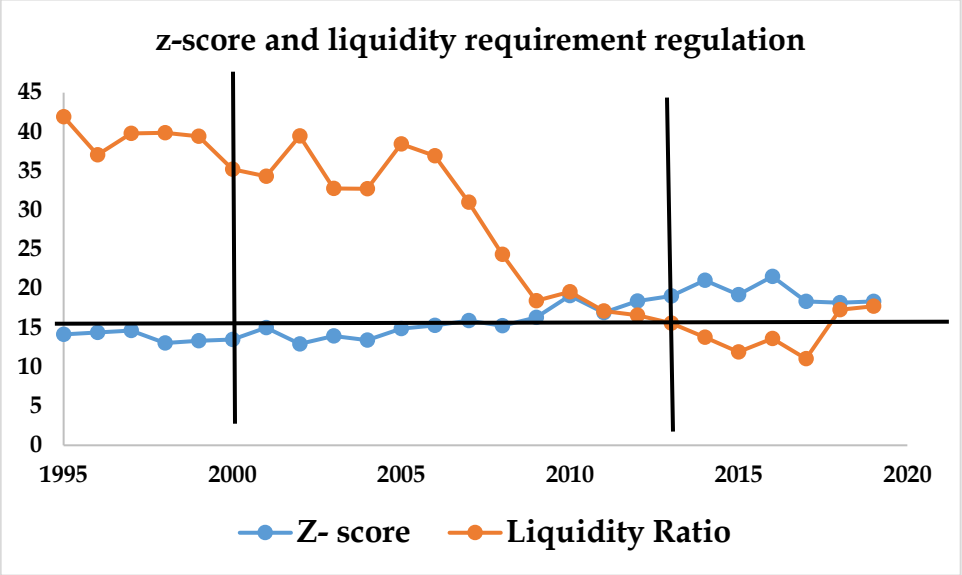
Minimum liquidity requirements make banks able to increase assets and allow them to meet obligations as they fall due. Basel regulation on the minimum liquidity requirement is due to its importance for maintaining financial stability. Because the lack of liquidity results systemic risk in the banking sector due to interconnected operations.

After the collapse of Chase bank Ltd in 2016, the CBK controlled liquidity. Low liquidity holding leads banks to a serious restriction from getting access to intraday liquidity, discount government securities, open market operation, and lender of last resort window.

Liquidity ratio in Kenya was above the minimum requirement until 2013. The ratio falls below the requirement after 2013 and back to above the minimum requirement after 2019. The relationship graph reveal that there is a negative relationship between minimum

liquidity requirement and z-score. This might be due to the liquidity management problem of banks during the banks crises happened in the country.

Figure 3.9: Relationship of financial stability and liquidity requirement regulation



Source: IMF and WB data

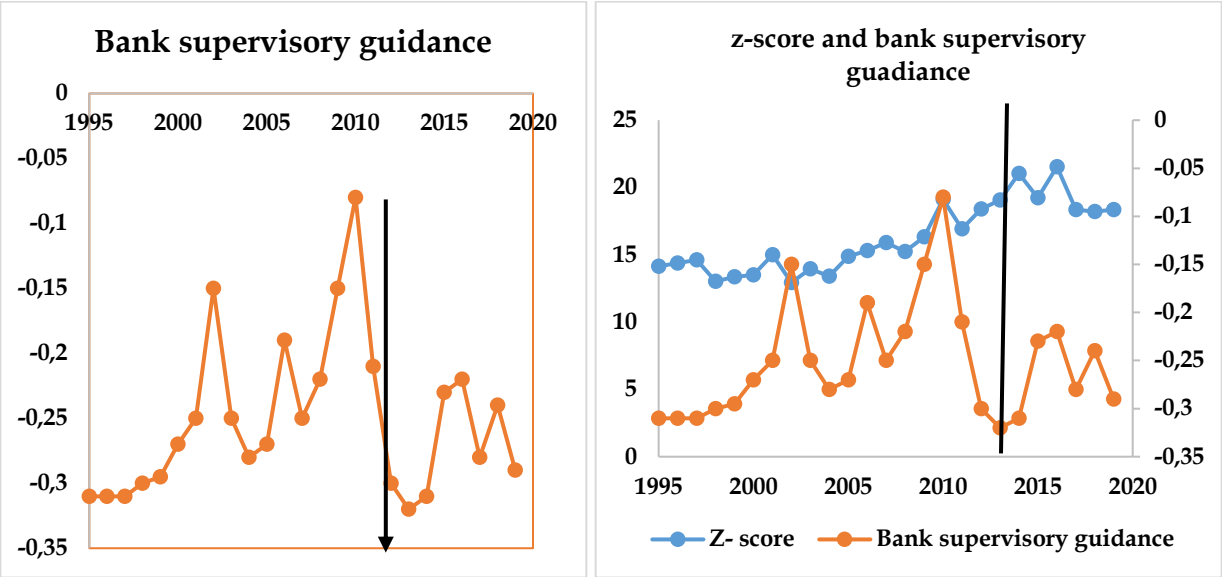
There was a higher degree of non-performing loan in the country resulted after lack of banks aggressive debt collection procedure in the country. An increase in the bad debt reduces Return On Asset (ROA). Then profit of banks decreased and it decreases liquidity. Then the minimum liquidity requirement regulation does not play a role in the stability of financial institutions in Kenya for the period of study under consideration. This should be checked by the econometrics result of the following section.

Bank Supervisory Guidance

This variable is measured by supervisory quality index. The figure 3.10 below clearly shows that the index for Kenya is negative for whole years. The level of supervisory index in Kenya is moderate as there are values that are near zero. The maximum is -0.05 and the minimum is -0.3. The relationship figure explains that the two variables have positive

relationship. This regulation is effectively started to implement after 2015 in the country. The value of z-score immediately starts to decline after this year. This implies that z- score is responsive for the shock in banks supervisory guidance, but this result has to be checked in the empirical analysis of section five.

Figure 3.10: Relationship of financial stability and bank supervision regulation



Source: CBK and WB data

4. EMPIRICAL METHODOLOGY OF THE STUDY

The main objective of this paper is to analyze the effectiveness of financial regulation on financial stability of Kenya. To this end, model specification, estimation techniques, and the type and sources of data for econometric investigation in the next chapter are briefly discussed under this chapter.

4.1 Source and type of data

The main sources of data are both domestic and international sources. Data is collected from domestic sources like Central Bank of Kenya (CBK). International Monetary Fund (IMF) and World Bank (WB) are international sources of data. A quarterly data ranging from 1995:1 to 2019:4 was collected to answer the research question of this study. This is due to the availability of data. Data of main variables are available in the database of source organizations starting from 1995. In addition, the topic of financial regulation and financial stability started to get the attention of researchers and policymakers of both developing and developed countries after the 1980s.

Table 4.1: Variables definitions, measurement and sources

Variables	Definition	Unit	Source
z_t	z-score, used to measure financial stability.	Ratio	WB
bc_t	Bank capital to total asset ratio. Used to measure bank capital and bank size.	Percentage	WB
g_t	Regulatory index. Measures bank supervisory guidance.	Index	CBK
l_t	Liquid assets to deposit and short funding. Used to measure liquidity coverage ratio.	Percentage	IMF
r_t	Bank regulatory capital to risk-weighted assets. Used to measure total capital regulations.	Percentage	IMF

4.2 Model Specification

The empirical literature review and the descriptive statistics of the previous sections shows that financial regulations are effective for financial stability. Therefore, this paper specifies an empirical model that is evaluated using the Structural Vector Autoregressive (SVAR) for confirming the effectiveness of financial regulations on the financial stability of Kenya.

Structural Vector Autoregressive (SVAR) model identifies structural shocks from Vector Autoregressive (VAR) models. SVAR models are better than other complex simultaneous equation models for the analysis of multivariate time series (Hossein and Kamuruzzaman, 2015). As it is indicated by Gottschalk (2001), Guay (2001), and Blanchard and Quah (1989), SVAR is estimated with the assumption of short-run restrictions of the feedback effect of variables contemporaneously. In addition to its importance in forecasting and data description, the SVAR model used for policy analysis purposes and structural inference and also provides forecasts of superior quality. Assumptions related to structural causality of data analysis are imposed and impacts of certain unexpected shocks are examined. In the SVAR model, the function of interest and causality is mostly analyzed using impulse response functions and variance decomposition forecast of the error term (Christiano, 2012).

The following equation shows the model specification of Structural Vector Autoregressive (SVAR) model:

$$AY_t = \alpha_0 + \alpha_1 Y_{t-1} + U_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots .. (1)$$

Where: **A** is a representation for a matrix of contemporaneous relationships

$\mathbf{Y_t}$ is a representation for vector of endogenous variables

$\boldsymbol{\alpha_1}$ is matrix of parameter

$\boldsymbol{\alpha_0}$ is a vector for a constant term

$\mathbf{U_t}$ Represents structural shocks, it assumed that they satisfy the orthogonal assumption of one to the other (explains only one shock at a time, two or more shocks cannot exist at the same time) there is also the assumption of no correlation among structural shocks. Meaning, the covariance between them is zero.

The vector of endogenous variables Y_t of equation (1) contains endogenous variables of the following form:

$$Y_t = [z_t, bc_t, g_t, l_t, r_t]$$

Where these vector of endogenous variables include z score (z_t), bank capital to total asset ratio (bc_t), regulatory quality index (g_t), liquidity assets to deposits and short funding ratio (l_t), and bank regulatory capital to risk-weighted assets ratio (r_t).

The above five vectors of endogenous variables considered under this study, based on theory, literature, and Basel Accord. Crockett (1997), suggested possible variables in the theory of financial stability. Bank capital to total asset ratio (bc_t) is selected for the analysis purpose of this model based on this theory. In the work of Mohr and Wagner (2013), all variables of this study are used in order to measure the nexus between financial regulation and financial stability. Shaddady and Moore (2019), used bank capital to total asset ratio (bc_t), regulatory quality index (g_t), and bank regulatory capital to risk-weighted assets ratio (r_t) for investigating the effect of financial regulation and supervision on financial stability. The three Basel regulations are the base for this model while we were selecting the financial regulation variables. Akande (2018), used liquidity requirement ratio, capital adequacy to risk weighted asset ratio and z score for evaluating competition, regulation, stability and efficiency of sub-Saharan African banks. Polizzi and Scannella (2020), to measure the role of financial regulation on the financial stability, use z score, liquidity requirement and capital adequacy to risk weighted asset ratio.

Variables ordering is decided based on the result of the Granger causality test. Therefore, Endogenous variables of this paper are ordered as $[z_t,\ bc_t, g_t, l_t, r_t]$. Mohr and Wagner

(2013) and Akande (2018), followed the same ordering and variable description. The paper adopted this ordering because the effectiveness of financial regulation on financial stability takes time and financial stability responds to financial regulation with a lag. However, the financial regulation variables have a contemporaneous response to financial stability.

Financial variable bank capital ordered next to z-score because it responds to the shock of financial stability contemporaneously. The ability of the government and the central bank of Kenya for bank supervisory guidance is ordered next to z-score and bank capital. The liquidity requirement ratio is the fourth variable that responds contemporaneously to financial stability variables and supervisory guidance as it is observed from the Granger causality result. Deposit takers' capital adequacy is measured by capital adequacy to the risk weighted assets. This variable is a proxy for all capital regulations that ultimately measures the extent of the robustness of financial institutions to various shocks in Kenya. It is contemporaneously responsive to the changes in the other endogenous variables of the model.

Introduction of matrix A is the first step in the identification of the Structural Vector Autoregressive model. Matrix A implies the contemporaneous relationship of endogenous variables of the model.

Equation (1) above ($\mathrm{AY_t} = \alpha_0 + \alpha_1 \mathrm{Y_{t-1}} + \mathrm{U_t} \ldots \ldots \ldots \ldots \ldots \ldots (1)$) should be written in reduced form. Therefore, equation (1) is multiplied by A^{-1} yields reduced form of SVAR

$$A^{-1}AY_t = A^{-1}\alpha_0 + A^{-1}\alpha_1 Y_{t-1} + A^{-1}U_t$$

$$Y_t = \delta_0 + \delta_1 Y_{t-1} + \varepsilon_t$$

$$\text{Where, } \delta_0 = A^{-1}\alpha_0,\ \delta_1 = A^{-1}\alpha_1$$

$$and\ \varepsilon_t = A^{-1}U_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

ε_t is residual or forecast error in the reduced VAR form.

$$Let\ A = \begin{bmatrix} 1 & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} \\ \beta_{21} & 1 & \beta_{23} & \beta_{24} & \beta_{25} \\ \beta_{31} & \beta_{32} & 1 & \beta_{34} & \beta_{35} \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & \beta_{45} \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 \end{bmatrix}$$

The above structural equation (1) can be written in a matrix form in equation (3) below.

$$\begin{bmatrix} 1 & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} \\ \beta_{21} & 1 & \beta_{23} & \beta_{24} & \beta_{25} \\ \beta_{31} & \beta_{32} & 1 & \beta_{34} & \beta_{35} \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & \beta_{45} \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 \end{bmatrix} \begin{bmatrix} z_t \\ bc_t \\ g_t \\ l_t \\ r_t \end{bmatrix} = \begin{bmatrix} \alpha_{10} \\ \alpha_{20} \\ \alpha_{30} \\ \alpha_{40} \\ \alpha_{50} \end{bmatrix} + \begin{bmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} & \alpha_{14} & \alpha_{15} \\ \alpha_{21} & \alpha_{22} & \alpha_{23} & \alpha_{24} & \alpha_{25} \\ \alpha_{31} & \alpha_{32} & \alpha_{33} & \alpha_{34} & \alpha_{35} \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & \alpha_{44} & \alpha_{45} \\ \alpha_{51} & \alpha_{52} & \alpha_{53} & \alpha_{54} & \alpha_{55} \end{bmatrix} \begin{bmatrix} z_{t-1} \\ bc_{t-1} \\ g_{t-1} \\ l_{t-1} \\ r_{t-1} \end{bmatrix} + \begin{bmatrix} U_{zt} \\ U_{bct} \\ U_{gt} \\ U_{lt} \\ U_{rt} \end{bmatrix} \ldots 3$$

In equation (2) above,($\varepsilon_t = A^{-1}U_t$) we have said that matrix A relates the forecast error of reduced form ε_t and the structural shocks U_t. It indicates that the linear combination of forecast errors of the structural shocks Guay (2001).The number of variables to be estimated in the SVAR exceeds that in the reduced form of VAR. Therefore, $\frac{n(n-1)}{2}$ restrictions are needed in matrix A. Zero restriction is imposed in matrix A to restrict the contemporaneous relations among endogenous variables in SVAR. The restriction is imposed both in matrix A and A^{-1} to show the link between the forecast error and structural shocks (Ouliaris et al, 2018). Then, the equation of zero restriction is presented below. The total number of variables (n) in this model is five. Using the formula for zero restriction results in 10 restriction impositions.

$$\begin{bmatrix} \varepsilon_{zt} \\ \varepsilon_{bct} \\ \varepsilon_{gt} \\ \varepsilon_{lt} \\ \varepsilon_{rt} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ \beta_{21} & 1 & 0 & 0 & 0 \\ \beta_{31} & \beta_{32} & 1 & 0 & 0 \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & 0 \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 \end{bmatrix} \begin{bmatrix} U_{zt} \\ U_{bct} \\ U_{gt} \\ U_{lt} \\ U_{rt} \end{bmatrix}$$

According to Ulrichs (2018), the SVAR model helps to estimate the effect of innovations, policies, and reforms as a function of the impulse responses to those shocks. It is assumed that financial stability is measured by z-score responses to the shocks on the financial regulation variables. Equation (1) of the SVAR is transformed into a sum of shocks representation of impulse response function. It is represented by equation (4) below. We

have to identify or isolate purely exogenous or purely independent shocks to the variable of interest and how the financial stability reacts to them is known as impulse responses. Indeed, the structural model isolates purely to exogenous shocks and gets the responses of the endogenous variables after the economy hits by this shock (Mohr and Wagner, 2013).

Impulse response equation: $z_t = z_0 + \sum_{i=0}^{\infty} \omega_{ih} U_{h(t-i)} \ldots\ldots\ldots (4)$

Where, z_t represents variable of interest, z_0 indicates initial conditions, ω_{ih} is the i^{th} impulse response associated with the U_h shocks.

Variable Description

Z-score

The z-score (or distance to default) is calculated as (ROA+equity/assets)/sd (ROA), where ROA is the average annual return on end-year assets and sd(ROA) is the standard deviation of ROA. This variable used to measure the financial stability of Kenya. Different studies like Kiemo et al (2019), Alshubiri (2017), Akande (2018), and Mutarindwa et al (2020) used Z-score for measuring financial stability in their model of analysis.

Bank Capital to total asset ratio (%)

This variable is calculated as the total capital and reserve of banks to total assets. Capital and reserve incorporate funds contributed by owners, retained earnings, general and special reserves, provisions, and valuation adjustments. In all countries, tier 1 capital is a common feature of their banking system that captures paid-up shares and common stock. Tier 2 and tier 3 capital measure for total regulatory capital. Any financial and non-financial asset can be counted as a total asset.

Regulatory index

This variable is the measurement for one of the Basel regulations called bank supervisory guidance. It captures the government's commitment and perception to adopt and

implement basic financial regulations that are recommended for the development of financial systems. It is an implication for Kenya's overall score for the adoption and implementation of financial regulations. In 2006, the Basel committee formulated 25 principles for bank supervision. The first principle explains that authorities involved in bank supervision should stick to the objective of Basel regulations, should be independent, transparent, and cooperative. The regulatory quality index ranges from -2.5 to 2.5. If the value is -2.5, the regulatory quality is very weak and the reverse will be true for 2.5.

Liquid assets to deposit and short funding (%)

This variable is calculated as the ratio of the value of easily convertible liquid assets to cash to short-term funding and plus total deposit. Liquidity asset incorporates Cash and securities. Total customer deposits like saving accounts, current accounts, and terms are short-term funding and deposits. Under short-term borrowing, many market instruments, and other deposits are found.

Bank regulatory capital to risk-weighted assets (%)

This variable is measured by banks' regulatory capital instruments to risk-weighted asset ratio. It is also known as the capital adequacy requirement ratio that measures banks' solvency. The higher ratio is an implication for banks' loss absorbance without affecting their solvency. The overall capital regulation in this model is measured by this variable. It consists of overall capital stringency; capital banks should hold an initial stringency.

4.3 Time series properties

Before carrying out the estimation of the above models, the time series characteristics of each data have to be investigated. This is because the SVAR model works under the assumption of Stationarity.

4.3.1 Stationary test

The SVAR model estimations are based on the assumption that all vectors of endogenous variables are stationary. It is common in time-series variables that most of them are not stationary. If the mean and the variance are constant over time, stationarity will exist. However, the covariance of two consecutive periods cannot be calculated on the actual time rather it depends on the gap or lag between two periods. A serious problem occurs if the model contains non-stationary variables. This problem is known as spurious regression, the result obtained have no economically meaningful causal relations. Non-stationery variables become stationary by differencing and the process is said to be a different stationary process (Harris, 1995).

In order to test the unit root of variables, the Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test are applied.

Augmented Dickey-Fuller (ADF) test

Adding the lagged values of the vector of endogenous variables is the procedure for taking care of the ADF test. Identification of the problem of autocorrelation in the mean of error terms is indirectly checked.

This is conducted as follows

$$\Delta Y_t = \alpha + \beta_t + \gamma Y_{t-1} + \delta_1 \Delta Y_{t-2} \dots + \delta_p \Delta Y_{t-p} + u_t \dots\dots\dots\dots (5)$$

Where p represents the maximum lag length, α *and* β indicate coefficients of the time trend, U_t is pure white noise and t is time period.

Phillips-Perron Test (PP)

The second method to test the unit root of variables is PP. The result and the hypothesis of this test is similar to the ADF test, the only difference is, correlation is checked in the estimation step in PP. The main drawback of PP is its difficulty to differentiate between stationary and non-stationary variables in PP when the sample size is small.

ADF and PP test:

$$H_0: y_t \sim I(1)$$

$$H_0: y_t \sim I(0)$$

There is a unit root in the variable is the null hypothesis of ADF and PP. If the null hypothesis is rejected, the variable is said to be stationary (Harris and Sollis 2003).

The next and most important step after the test of stationary is the decision of lag length for the model under consideration. Akaike Information Criterion (AIC) or Schwarz Bayesian Criterion (SBC) is the commonly used criteria for selecting a lag length. In this study, the model with the smallest AIC or BIC is preferred. BIC is sometimes preferred to AIC as it has a property of certainty to select a true model.

4.3.2 Diagnostic tests

Finally, it is necessary to do a diagnostic test (LM test of serial correlation and stability tests) on the estimated result of the short-run equation to make sure that the estimated results are valid enough in order to be used for forecasting or policy purposes.

5. RESULTS AND DISCUSSION

Section 3 dealt with the trend analysis of variables from empirical models and indicators of the financial system. This section presents the result of econometric analysis. Specifically, results of Granger causality test, stationarity (unit root) test, SVAR model estimation results, impulse response results, Variance decomposition results and robustness test results are discussed.

5.1 Result of Granger Causality Test

As it is briefly explained in the empirical methodology of the previous section, variables ordering of this study is checked with Granger causality. It is observed that policy variables are contemporaneously responsive for the change in the financial stability, but financial stability is not contemporaneously affected by policy variables.

Table 5.1: Result of Granger causality test

Null hypothesis	F-Statistics	Probability
bc_t does not Granger cause z_t	0.60615	0.6592
z_t does not Granger cause bc_t	0.36325	0.0357
g_t does not Granger cause z_t	0.01384	0.9996
z_t does not Granger cause g_t	4.96286	0.0131
l_t does not Granger cause z_t	1.86661	0.1235
z_t does not Granger cause l_t	4.83677	0.0014
r_t does not Granger cause z_t	0.93042	0.4502
z_t does not Granger cause r_t	4.85568	0.0014
g_t does not Granger cause bc_t	0.11251	0.9778
bc_t does not Granger cause g_t	0.28095	0.8896
l_t does not Granger cause bc_t	0.31823	0.8951
bc_t does not Granger cause l_t	4.07581	0.0045
r_t does not Granger cause bc_t	1.52224	0.2027
bc_t does not Granger cause r_t	0.46196	0.7634
l_t does not Granger cause g_t	0.20313	0.9360
g_t does not Granger cause l_t	4.69325	0.0236
r_t does not Granger cause g_t	0.11022	0.9786
g_t does not Granger cause r_t	0.24627	0.9112
r_t does not Granger cause l_t	1.63143	0.1736
l_t does not Granger cause r_t	2.09279	0.0886

5.2 Results of Unit Root Test

Unit root test is conducted using both Augmented-Dickey Fuller (ADF) test and Phillip-Peron (PP) test. The ADF test result reveals that z-score (at 10 % level of significance), bank capital to total asset ratio (at 10% level of significance), and bank regulatory capital to risk-weighted assets ratio (at 10% level of significance) are stationary at level. The remaining variables are stationary at their first difference and at 1% level of significance. The PP test result reported that all variables are stationary at their first difference and at 1% level of significance (See Appendix 2 for the result table).

5.3 Report of Optimal Lag Length Selection Criteria

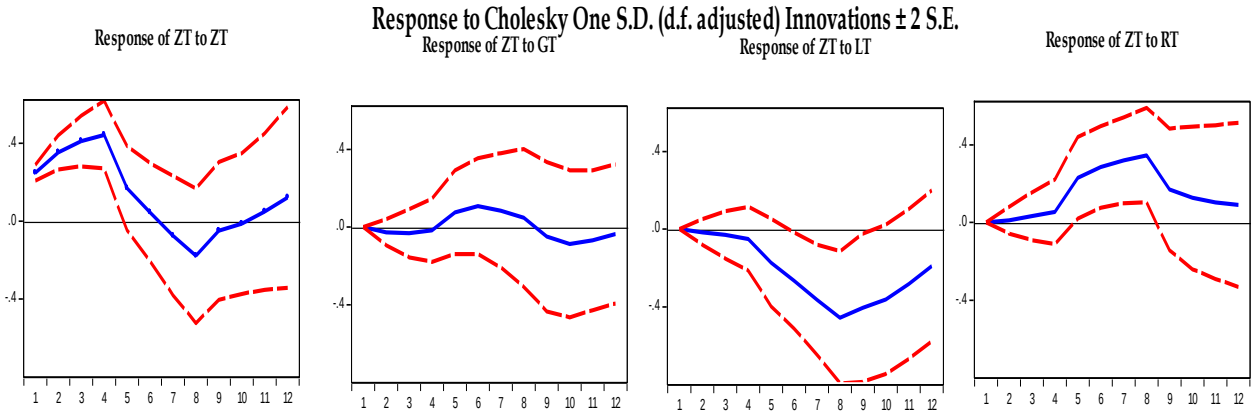
Before conducting the SVAR estimation, the decision on the lag length selection is important. This is because SVAR is very sensitive to the order of lags selected for analysis. Including many lags leads to an error of forecast and waste in the degree of freedom. While the inclusion of a very little number of lags makes the size of the result incorrect. All criteria except the Schwarz information criteria (two lags selected), approve the lag length of six at a 5% level of significance (See appendix 3 for test result).

The SVAR estimation starts from estimating the result of Vector Autoregressive (VAR). The full result of the VAR model estimation and SVAR estimation results are presented in the Appendix 4 and 5. In addition, Diagnostic test results of the model in this paper are presented in appendix 6.

5.4 Impulse Response Results

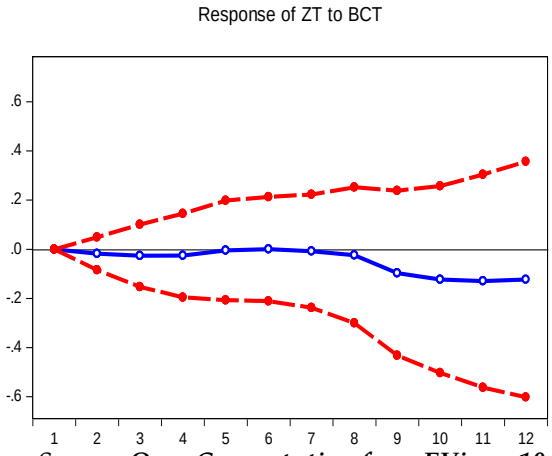
In this sub section, the result of impulse response function is discussed. The Impulse response result for all vector of endogenous variables is reported in Appendix 7.1 below. Only selected figures are presented in this section to show the response of financial stability to financial regulation variables.

Figure 5.1: Impulse response result: of z-score and financial regulation variables



Source: Own Computation from EViews 10

Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.



Source: Own Computation from EViews 10

The response of z-score to the change in the financial variable of bank capital to total assets ratio (bc_t) is economically insignificant.

To address the long-run responses of financial stability to shocks in financial regulation variables, we use Impulse Response Functions (IRF). We performed the analysis over a 12-period horizon. The financial stability of Kenya is measured by a z-score. It relates negatively to the vulnerability of a bank's profit. The innovation in financial stability has an economically significant effect on the current financial stability of Kenya.

A dramatic change in bank's prudential- regulation is observed since the world financial regulation. Minimum liquidity requirement (l_t) is one regulation of the Basel Committee. The objective of this requirement is to make banks safer. It has a role in mitigating liquidity risks, solvency risks and it encourages financial institutions to develop good risk

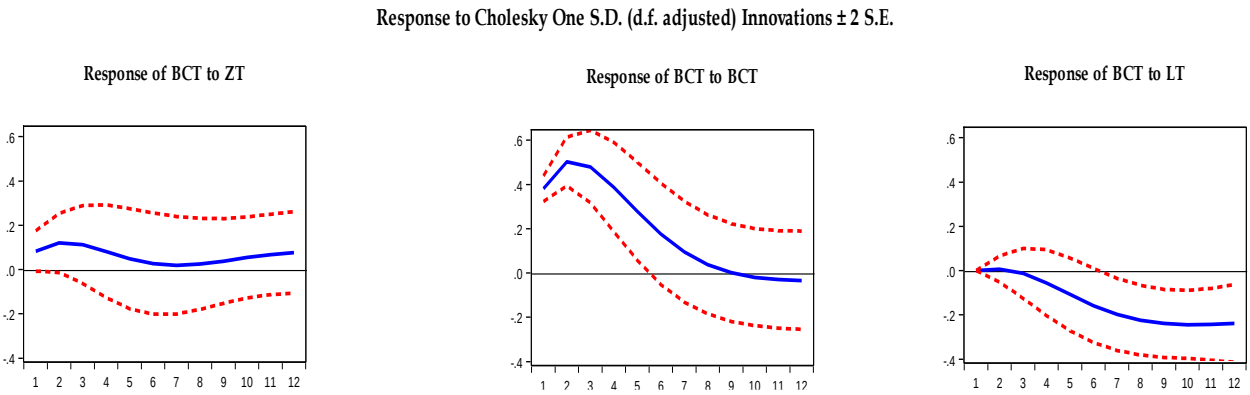
management abilities. However, in Kenya, the response of financial stability for the shocks in the minimum liquidity requirement ratio is negative. The result is statistically significant, but the sign is unexpected. It is because the regulation requires banks to hold more cash that results to issue fewer loans on business and consumers. This leads to slower economic growth because companies with better investment opportunities have no access to capital during the time they need debt to fund their operations and to expand their business. In addition, Kenyan central bank applied a strict regulation on banks with a higher minimum liquidity requirements creates an idle liquidity that has no power to stabilize the financial sector of the country. Therefore, liquidity minimum requirement regulation does not have financial stability benefits. The result is in line with Hoerova et al (2018), Polizzi, and Scannella (2020).

The change in the capital adequacy ratio (r_t) has a significant effect on the financial stability of Kenya. A permanent positive response of financial stability for the shocks in capital adequacy ratio confirms the financial stability benefit of capital regulation in Kenya. In addition, the survival of banks will go up as capital regulations provide incentives to better monitor and borrower's identification. Capital regulations are difficult and costly to implement, as information about the true quality of bank balance sheets is imperfect. However, in Kenya, the change in this variable is beneficial to financial stability. The result is similar to the results found by Shaddady and Moore (2019) and Mwega (2014).

A shock to bank supervisory guidance (g_t) has no statistically significant effect on the financial stability of Kenya. This result is due to the inefficient implementation of this regulation in the country. As it is indicated in the Basel implementation challenges of Kenya (section 2), Bank supervisory guidance requires highly qualified, responsible, transparent, and independent authorities. In Kenya, there was the intervention of the government in the activities of the countries Central banks. In addition, as it is reported by CBK (2020), non-compliance is noted during the supervisory process. To mention some of the requirements violated by the country's financial institutions: single

obligatory limit, prohibited business, capital adequacy requirements, insider lending, and liquidity management, restrictions on advances, credit and grantees, and restrictions on advances for purchase of land. These implementation problems of bank supervisory guidance contributed to its insignificant effect on the financial stability of Kenya.

Figure 5.2: Impulse response result: of bank capital to liquidity requirement ratio



Source: Own Computation from EViews 10

The study treated bank capital to total assets ratio (bc_t) as a financial variable that determines the financial stability of Kenya. The response of bank capital to total asset ratio for minimum liquidity requirement ratio is negative. There is a continues negative and significant effect of minimum liquidity requirement ratio on the size of bank capital. The minimum liquidity requirement ratio aimed to allow financial institutions to have a sufficient liquidity in times of short-term disruptions. This requirement needs effective liquidity management that enables to estimate the adequate liquidity which is enough to meet the demand of depositors. However in Kenya, there is implementation problem of this regulation as the minimum requirement creates excess liquidity that is not able to promote bank's capital to total asset. It is due to the inability of supervisor's in the estimation of the minimum requirement that is enough for financial cushion for banks to fund cash outflows for 30 days.

5.5 Result of Variance Decomposition

In this sub-section, the result of variance decomposition is discussed. Variance decomposition shows the degree of the forecast error variance of every single variable in the model can be explained by shocks that are exogenous to the remaining variables (Akande, 2018). It also considers information on the proportion of movements in a sequence that are due to the shock in the variable itself and other shocks identified. It distinguishes the variation of the endogenous shocks into the component shocks of SVAR.

Table 5.2: Result of variance decomposition of D(zt)

Period	$D(z_t)$	$D(bc_t)$	$D(g_t)$	$D(l_t)$	$D(r_t)$
1	100.00	0.00	0.00	0.00	0.00
4	95.30	0.28	1.29	1.05	2.10
8	36.74	0.14	0.66	20.39	42.11
12	27.54	2.61	1.11	25.85	42.90

Source: Own computation using EViews 10

The result of variance decomposition indicates that, in Kenya, the main source of fluctuation in financial stability is from financial stability, capital adequacy to risk-weighted assets ratio and liquidity coverage ratio. In the first quarter of 1995, the fluctuation in financial stability was fully from financial stability itself. This result is parallel to the assumption we made in the previous section that shocks in the financial regulation variables transmitted to financial regulation with a lag. The contribution of financial stability decreases to 27.54% in the 12^{th} quarter. On average, around 12% of the variation in the financial stability of Kenya is occurred by liquidity requirement ratio. In the 12^{th} quarter, 25.85% of fluctuation in financial stability was from the liquidity requirement ratio. This variation was around 20.39% in the previous quarter (quarter 8).

This result is consistent with the result of impulse response that implies that the variation in financial stability is better explained by the liquidity requirement ratio. The 42.11% of fluctuation in financial stability is from shocks in capital regulation in the 8th quarter and increases to 42.90 % in the 12th quarter.

To sum up, financial regulation variables have statistically significant effect from the impulse response result and it is confirmed from the variance decomposition result. The change in financial stability that proxies by z score explain the fluctuation of financial stability in Kenya by 27.54%, capital regulation shocks explains by 42.90%, and liquidity ratio by 25.85% in the 12th period. Therefore, it is easy to conclude that the effect of financial regulation variables on financial stability increases as time goes up. This is confirmed by the contribution of capital adequacy ratio. It was reported in the first quarter of the variance decomposition result that this variable has no significant effect on the financial stability of Kenya. However, it is observed that the contribution increases gradually from zero to 42.90%. This means, the implementation of this regulation takes time to affect the financial stability of Kenya.

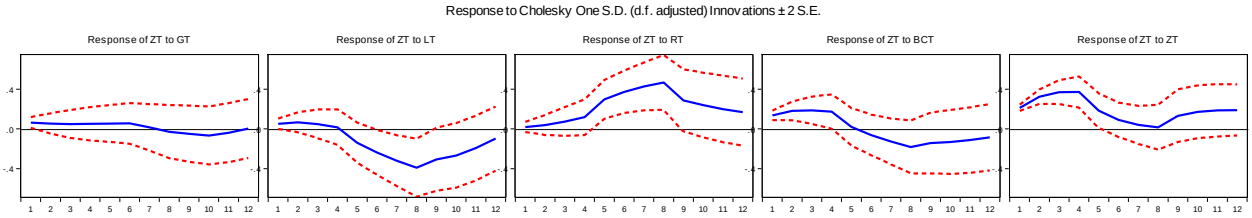
5.6 Result of Robustness Test

The variable ordering of this study is decided after analyzing previous works, theories and recommendations of Basel Accord. In addition, the ordering is made using Granger causality result. The current ordering assumes that financial stability is not contemporaneously affected by policy variables and the ordering was the following, $[z_t, bc_t, g_t, l_t, r_t]$. But alternative orderings could be imagined in order to check whether the results we found are robust to change in the ordering or not.

Possible orderings of endogenous variables are tested under this section and it is obvious that reporting of all the possible combinations of orderings is impossible. Only two results are presented in this section.

The first ordering is $[g_t, l_t, r_t, bc_t, z_t]$, this ordering assumed that policy variables contemporaneously affect financial stability of Kenya. The implementation of Basel regulations affects financial stability on spot. The impulse response test result reveals similar results with the model of the current study. It confirms that the results are not sensitive to changes (See appendix 7.2 below for all results).

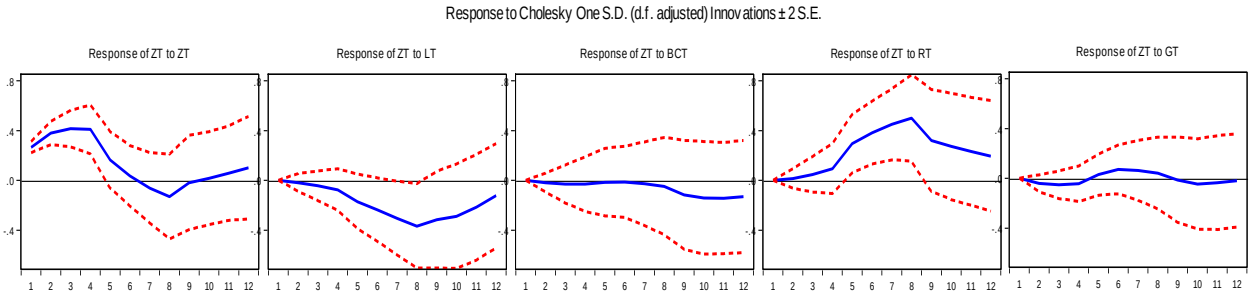
Figure 5.3: Impulse response result of $[g_t, l_t, r_t, bc_t, z_t]$



Source: Own computation using EViews 10

The second ordering assumed the change in the ordering of financial regulation variables yields a result that is sensitive to change, $[z_t, l_t, bc_t, r_t, g_t]$. However, the result reveals that there is no change in the result of the model. Statistically significant financial regulation variables are economically meaningful in the new ordering and insignificant variables are stayed the same (See appendix 7.3 below for the full report).

Figure 5.4: Impulse response result of $[z_t, l_t, bc_t, r_t, g_t]$



Source: Own computation using EViews 10

6. CONCLUSION AND POLICY IMPLICATIONS

The present study examined the effectiveness of financial regulations on the financial stability of Kenya using the Structural Vector Autoregressive model. In order to examine the main objective of the study, a time series data ranging from 1995:1 to 2019:4 is employed. The major financial regulation variables of this paper are developed from the three Basel implementations in the country. These variables are the Capital adequacy ratio, bank supervisory guidance measured by the supervisory quality index of Kenya, and liquidity coverage ratio.

Kenya's financial system performance is measured by key financial institution and financial market indicators of financial depth, access and efficiency and compared with the average value of its income group, LMICs. The result of trend analysis showed that the country's financial system lags behind the average of LMICs. A permanent positive response of financial stability for the shocks in capital adequacy ratio confirms the financial stability benefit of capital regulation in Kenya. Minimum liquidity requirement regulation of Basel Accord has economically significant, but negative effect in the financial stability of Kenya. A one standard deviation shock to bank supervisory guidance has no statistically significant effect on the financial stability of Kenya. This result is due to the inefficient implementation of this regulation in the country. The variance decomposition result implies that the shock to financial stability explains the 27.54 % of fluctuations in the financial stability of Kenya, capital regulation shock and liquidity coverage ratio explains 42.90% and 25.85% respectively.

Based on the main findings of the study, the following key policies are recommended:

The central bank of Kenya needs to hire highly qualified, responsible, transparent, and independent staff for the implementation of financial regulations like bank supervision. A conducive financial environment is essential for the implementation of Basel Accords as the result supports that financial regulations have a significant effect on the financial stability of Kenya.

Efforts on managerial efficiency and information about the true quality of bank balance sheets need a priority for the successful implementation of Basel.

Limitations of the study and scope for future researchers

This study examined the effectiveness of financial regulation on the financial stability of Kenya. It tried to fill on the existing methodology, time and literature gap. However, the study has its own limitations which will be addressed by future researchers. One objective of the paper was to measure the performance of financial system in Kenya. The objective was planned to address by making comparison with the performance of other countries. However, the comparison is made only for financial depth due to data unavailability for other characteristics. In addition, this study is conducted in a single country case due to time limitation. I suggest to explore the effectiveness of financial regulation on the financial stability of developing countries using a panel data analysis by considering potential representative countries to get a deep insight on the effectiveness of Basel Accords. Thus, future researchers can intervene on this topic by taking this limitations into account.

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APPENDICES

Appendix 1: Granger Causality Test result

Pairwise Granger Causality Tests
Date: 05/11/21 Time: 12:38
Sample: 1995Q1 2019Q4
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
BCT does not Granger Cause ZT	96	0.60615	0.6592
ZT does not Granger Cause BCT		3.69325	0.0357
GT does not Granger Cause ZT	96	0.01384	0.9996
ZT does not Granger Cause GT		4.96286	0.0131
LT does not Granger Cause ZT	96	1.86661	0.1235
ZT does not Granger Cause LT		4.83677	0.0014
RT does not Granger Cause ZT	96	0.93042	0.4502
ZT does not Granger Cause RT		4.85568	0.0014
GT does not Granger Cause BCT	96	0.11251	0.9778
BCT does not Granger Cause GT		0.28095	0.8896
LT does not Granger Cause BCT	96	0.31823	0.8651
BCT does not Granger Cause LT		4.07581	0.0045
RT does not Granger Cause BCT	96	1.52224	0.2027
BCT does not Granger Cause RT		0.46196	0.7634
LT does not Granger Cause GT	96	0.20313	0.9360
GT does not Granger Cause LT		1.63124	0.1736
RT does not Granger Cause GT	96	0.11022	0.9786
GT does not Granger Cause RT		0.24627	0.9112
RT does not Granger Cause LT	96	1.63143	0.1736
LT does not Granger Cause RT		2.09279	0.0886

Appendix 2: Unit Root Test Result

Appendix 2.1: ADF unit root test result

Variable	t-statistics of ADF test	Critical Value of ADF test	P-value of ADF test	Order of integration
Z-score(z_t)	-3.432839	-3.153989	0.0529	I(0)*
Bank capital to total asset ratio (bc_t)	-3.175690	-3.153989	0.0954	I(0)*
Bank supervisory guidance (g_t)	-4.993172	-3.498439	0.0001	I(1)***
Liquid assets to deposit and short funding (l_t)	-5.310574	-4.054393	0.0001	I(1)***
Bank regulatory capital to risk-weighted assets (r_t)	-3.295655	-3.153989	0.0730	I(0)*

Appendix 2.2: PP unit root test result

Variable	t-statistic of PP test	Critical Value of PP test	P-value of PP test	Order of integration
Z-score(z_t)	-6.538569	-3.498439	0.0000	I(1)***
Bank capital to total asset ratio (bc_t)	-5.858632	-3.498439	0.0000	I(1)***
Bank supervisory guidance (g_t)	-4.923929	-3.498439	0.0001	I(1)***
Liquid assets to deposit and short funding (l_t)	-5.254918	-4.054393	0.0002	I(1)***
Bank regulatory capital to risk-weighted assets (r_t)	-5.891563	-3.498439	0.0000	I(1)***

******, and * shows 1%, and 10% level of significance respectively, there is a unit root is the null hypothesis of this test.***

Source: Own computation using EViews 10

Appendix 3: Lag Length selection

Lag	LR	FPE	AIC	SC	HQ
0	NA	22.80060	20.15404	20.31851	20.22042
1	1258.422	1.86e-05	6.131691	7.282942	6.596346
2	151.4258	6.03e-06	4.997517	7.135555*	5.860448
3	26.15027	9.45e-06	5.421903	8.546728	6.683109
4	13.03122	1.79e-05	6.010016	10.12163	7.669497
5	213.1699	1.28e-06	3.298036	8.396435	5.355793
6	66.15194*	9.56e-07*	2.877882*	8.963068	5.333915*
7	14.83426	1.86e-06	3.357751	10.42972	6.212059
8	18.65638	3.42e-06	3.706490	11.76525	6.959074

** indicates lag order selected by the criterion*

Source: Own computation using EViews 10

Appendix 4: VAR Estimation Result

Vector Autoregression Estimates
Date: 05/11/21 Time: 12:24
Sample (adjusted): 1996Q3 2019Q4
Included observations: 94 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	ZT	BCT	GT	LT	RT

ZT(-1)	1.528677	0.020002	0.006128	0.023305	0.432628
	(0.12969)	(0.15401)	(0.01367)	(0.45184)	(0.28560)
	[11.7876]	[0.12988]	[0.44829]	[0.05158]	[1.51482]
ZT(-2)	-0.602093	-0.062621	-0.009329	-0.192399	-0.396656
	(0.14977)	(0.17785)	(0.01579)	(0.52181)	(0.32982)
	[-4.02020]	[-0.35209]	[-0.59100]	[-0.36871]	[-1.20263]
ZT(-3)	-0.019374	-0.005026	-0.001721	0.031188	-0.012553
	(0.09454)	(0.11227)	(0.00996)	(0.32938)	(0.20819)
	[-0.20494]	[-0.04477]	[-0.17274]	[0.09469]	[-0.06030]
ZT(-4)	-0.786497	0.109872	0.008677	-0.221159	-0.236398
	(0.09454)	(0.11227)	(0.00996)	(0.32939)	(0.20820)
	[-8.31922]	[0.97864]	[0.87084]	[-0.67142]	[-1.13544]
ZT(-5)	1.219766	-0.156325	-0.002758	0.419513	0.647381
	(0.14271)	(0.16947)	(0.01504)	(0.49721)	(0.31428)
	[8.54733]	[-0.92243]	[-0.18339]	[0.84373]	[2.05992]
ZT(-6)	-0.520872	0.000373	-0.008221	-0.357045	-0.425661
	(0.11723)	(0.13921)	(0.01236)	(0.40844)	(0.25816)
	[-4.44326]	[0.00268]	[-0.66536]	[-0.87417]	[-1.64881]
BCT(-1)	-0.094457	1.453901	-0.002760	0.093724	-0.257528
	(0.11288)	(0.13404)	(0.01190)	(0.39327)	(0.24858)
	[-0.83682]	[10.8464]	[-0.23203]	[0.23832]	[-1.03600]
BCT(-2)	0.119747	-0.431971	0.001884	-0.068407	0.199631
	(0.15630)	(0.18562)	(0.01647)	(0.54458)	(0.34422)
	[0.76612]	[-2.32723]	[0.11438]	[-0.12561]	[0.57996]
BCT(-3)	-0.012896	-0.050093	0.001977	0.012907	0.006682
	(0.13264)	(0.15751)	(0.01398)	(0.46212)	(0.29209)
	[-0.09723]	[-0.31803]	[0.14145]	[0.02793]	[0.02288]
BCT(-4)	-0.082891	-0.821145	-0.011211	0.049647	-0.304450
	(0.13266)	(0.15754)	(0.01398)	(0.46221)	(0.29215)
	[-0.62483]	[-5.21222]	[-0.80176]	[0.10741]	[-1.04209]
BCT(-5)	0.034856	1.162739	0.008988	0.050850	0.244293
	(0.15474)	(0.18376)	(0.01631)	(0.53913)	(0.34077)
	[0.22526]	[6.32750]	[0.55106]	[0.09432]	[0.71688]
BCT(-6)	0.041855	-0.433834	-0.000340	-0.165920	0.002762
	(0.10330)	(0.12267)	(0.01089)	(0.35990)	(0.22748)
	[0.40519]	[-3.53666]	[-0.03125]	[-0.46102]	[0.01214]
GT(-1)	-1.472915	-1.022657	0.817518	-7.153259	-0.608574
	(1.22928)	(1.45982)	(0.12957)	(4.28299)	(2.70717)
	[-1.19819]	[-0.70054]	[6.30965]	[-1.67016]	[-0.22480]
GT(-2)	1.393315	0.757061	0.033127	1.730952	0.271406
	(1.57127)	(1.86595)	(0.16561)	(5.47454)	(3.46032)
	[0.88674]	[0.40572]	[0.20002]	[0.31618]	[0.07843]
GT(-3)	0.176036	0.381184	0.007986	0.965974	0.275078

	(1.53298)	(1.82048)	(0.16158)	(5.34113)	(3.37599)
	[0.11483]	[0.20939]	[0.04942]	[0.18086]	[0.08148]
GT(-4)	2.113222	1.329751	0.258166	0.334527	-0.651205
	(1.55335)	(1.84467)	(0.16372)	(5.41209)	(3.42085)
	[1.36043]	[0.72086]	[1.57685]	[0.06181]	[-0.19036]
GT(-5)	-2.971650	-2.003984	-0.223208	0.815262	0.007887
	(1.59894)	(1.89881)	(0.16853)	(5.57093)	(3.52124)
	[-1.85852]	[-1.05539]	[-1.32446]	[0.14634]	[0.00224]
GT(-6)	-0.536024	0.152711	-0.107030	-1.924061	2.085779
	(1.26356)	(1.50054)	(0.13318)	(4.40244)	(2.78267)
	[-0.42422]	[0.10177]	[-0.80365]	[-0.43704]	[0.74956]
LT(-1)	-0.008948	-0.018576	0.000931	1.445423	-0.092174
	(0.03783)	(0.04492)	(0.00399)	(0.13180)	(0.08331)
	[-0.23654]	[-0.41349]	[0.23343]	[10.9665]	[-1.10640]
LT(-2)	-0.000503	-0.002123	-0.001253	-0.371020	0.054004
	(0.06169)	(0.07326)	(0.00650)	(0.21495)	(0.13586)
	[-0.00815]	[-0.02897]	[-0.19271]	[-1.72610]	[0.39749]
LT(-3)	0.004693	0.001155	0.002343	-0.093654	0.003423
	(0.05951)	(0.07067)	(0.00627)	(0.20733)	(0.13105)
	[0.07886]	[0.01635]	[0.37362]	[-0.45171]	[0.02612]
LT(-4)	-0.042769	-0.041282	-0.015854	-0.522932	0.158725
	(0.05968)	(0.07087)	(0.00629)	(0.20792)	(0.13142)
	[-0.71668]	[-0.58252]	[-2.52049]	[-2.51504]	[1.20775]
LT(-5)	0.036807	0.055001	0.015764	0.602398	-0.247751
	(0.06254)	(0.07427)	(0.00659)	(0.21791)	(0.13773)
	[0.58851]	[0.74053]	[2.39145]	[2.76446]	[-1.79877]
LT(-6)	-0.011256	-0.030917	-0.003635	-0.182091	0.082875
	(0.03679)	(0.04369)	(0.00388)	(0.12818)	(0.08102)
	[-0.30597]	[-0.70767]	[-0.93759]	[-1.42064]	[1.02294]
RT(-1)	0.028573	-0.039735	-0.000171	-0.096808	1.356070
	(0.05772)	(0.06854)	(0.00608)	(0.20110)	(0.12711)
	[0.49504]	[-0.57972]	[-0.02815]	[-0.48139]	[10.6685]
RT(-2)	0.003519	0.037997	0.001530	-0.044619	-0.328714
	(0.08698)	(0.10329)	(0.00917)	(0.30304)	(0.19154)
	[0.04046]	[0.36788]	[0.16692]	[-0.14724]	[-1.71615]
RT(-3)	0.000401	-0.001473	0.001701	0.026587	-0.075870
	(0.07902)	(0.09384)	(0.00833)	(0.27531)	(0.17402)
	[0.00507]	[-0.01569]	[0.20423]	[0.09657]	[-0.43599]
RT(-4)	0.265825	0.068200	-0.017732	-0.272181	-0.575539
	(0.07908)	(0.09392)	(0.00834)	(0.27554)	(0.17416)
	[3.36127]	[0.72618]	[-2.12728]	[-0.98780]	[-3.30459]
RT(-5)	-0.426074	-0.174284	0.012416	0.249162	0.551540
	(0.09623)	(0.11427)	(0.01014)	(0.33527)	(0.21191)

	[-4.42783]	[-1.52515]	[1.22415]	[0.74318]	[2.60267]
RT(-6)	0.221709	0.127641	0.002927	-0.067603	-0.086378
	(0.06654)	(0.07901)	(0.00701)	(0.23182)	(0.14653)
	[3.33219]	[1.61543]	[0.41741]	[-0.29162]	[-0.58950]
C	1.478910	3.672718	0.116338	10.63936	5.559102
	(1.32590)	(1.57457)	(0.13975)	(4.61964)	(2.91996)
	[1.11540]	[2.33252]	[0.83247]	[2.30307]	[1.90383]
R-squared	0.992766	0.983300	0.847121	0.994784	0.964904
Adj. R-squared	0.989322	0.975347	0.774322	0.992300	0.948192
Sum sq. Resids	4.480532	6.318712	0.049775	54.39036	21.72996
S.E. equation	0.266682	0.316697	0.028108	0.929160	0.587299
F-statistic	288.2049	123.6449	11.63638	400.5000	57.73598
Log likelihood	9.666769	-6.490593	221.1660	-107.6662	-64.54389
Akaike AIC	0.453899	0.797672	-4.046085	2.950344	2.032849
Schwarz SC	1.292645	1.636418	-3.207339	3.789090	2.871595
Mean dependent	16.38026	13.13701	-0.247660	26.18904	17.91217
S.D. dependent	2.580720	2.017011	0.059169	10.58880	2.580237

Determinant resid covariance (dof adj.)	9.05E-07
Determinant resid covariance	1.22E-07
Log likelihood	81.16684
Akaike information criterion	1.570918
Schwarz criterion	5.764649
Number of coefficients	155

Appendix 5: SVAR Estimation Result

Structural VAR Estimates
Date: 05/11/21 Time: 12:24
Sample (adjusted): 1996Q3 2019Q4
Included observations: 94 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 20 iterations
Structural VAR is just-identified

Model: Ae = Bu where E[uu']=I

A =

1	0	0	0	0
C(1)	1	0	0	0
C(2)	C(5)	1	0	0
C(3)	C(6)	C(8)	1	0
C(4)	C(7)	C(9)	C(10)	1

B =

C(11)	0	0	0	0
0	C(12)	0	0	0
0	0	C(13)	0	0
0	0	0	C(14)	0
0	0	0	0	C(15)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	-0.648579	0.102605	-6.321145	0.0000
C(2)	-0.029806	0.012565	-2.372221	0.0177
C(3)	-0.820552	0.421591	-1.946324	0.0516
C(4)	0.177896	0.270038	0.658783	0.5100
C(5)	0.006554	0.010580	0.619467	0.5356
C(6)	0.171098	0.345542	0.495158	0.6205
C(7)	-0.522776	0.217280	-2.405997	0.0161
C(8)	-5.483627	3.361604	-1.631253	0.1028
C(9)	-0.863603	2.140732	-0.403415	0.6866
C(10)	0.130692	0.064772	2.017715	0.0436
C(11)	0.266682	0.019450	13.71131	0.0000
C(12)	0.265293	0.019348	13.71131	0.0000
C(13)	0.027214	0.001985	13.71131	0.0000
C(14)	0.886962	0.064688	13.71131	0.0000
C(15)	0.557005	0.040624	13.71131	0.0000
Log likelihood	-12.87077			
Estimated A matrix:				
1.000000	0.000000	0.000000	0.000000	0.000000
-0.648579	1.000000	0.000000	0.000000	0.000000
-0.029806	0.006554	1.000000	0.000000	0.000000
-0.820552	0.171098	-5.483627	1.000000	0.000000
0.177896	-0.522776	-0.863603	0.130692	1.000000
Estimated B matrix:				
0.266682	0.000000	0.000000	0.000000	0.000000
0.000000	0.265293	0.000000	0.000000	0.000000
0.000000	0.000000	0.027214	0.000000	0.000000
0.000000	0.000000	0.000000	0.886962	0.000000
0.000000	0.000000	0.000000	0.000000	0.557005
Estimated S matrix:				
0.266682	0.000000	0.000000	0.000000	0.000000
0.172965	0.265293	0.000000	0.000000	0.000000
0.006815	-0.001739	0.027214	0.000000	0.000000
0.226605	-0.054926	0.149232	0.886962	0.000000
0.019250	0.144365	0.003999	-0.115919	0.557005
Estimated F matrix:				
2.362620	-2.353911	6.754259	-11.21504	13.33782
0.916807	0.604643	5.741879	-8.385742	7.703761
-0.022123	-0.022239	0.155325	-0.003400	-0.045403
-3.865854	10.25722	-34.42530	51.66174	-52.70322
0.427317	-2.467631	6.682333	-8.941717	12.14479

Appendix 6: Autocorrelation Test Results

VAR Residual Serial Correlation LM Tests
Date: 04/16/21 Time: 16:13
Sample: 1995Q1 2019Q4
Included observations: 94

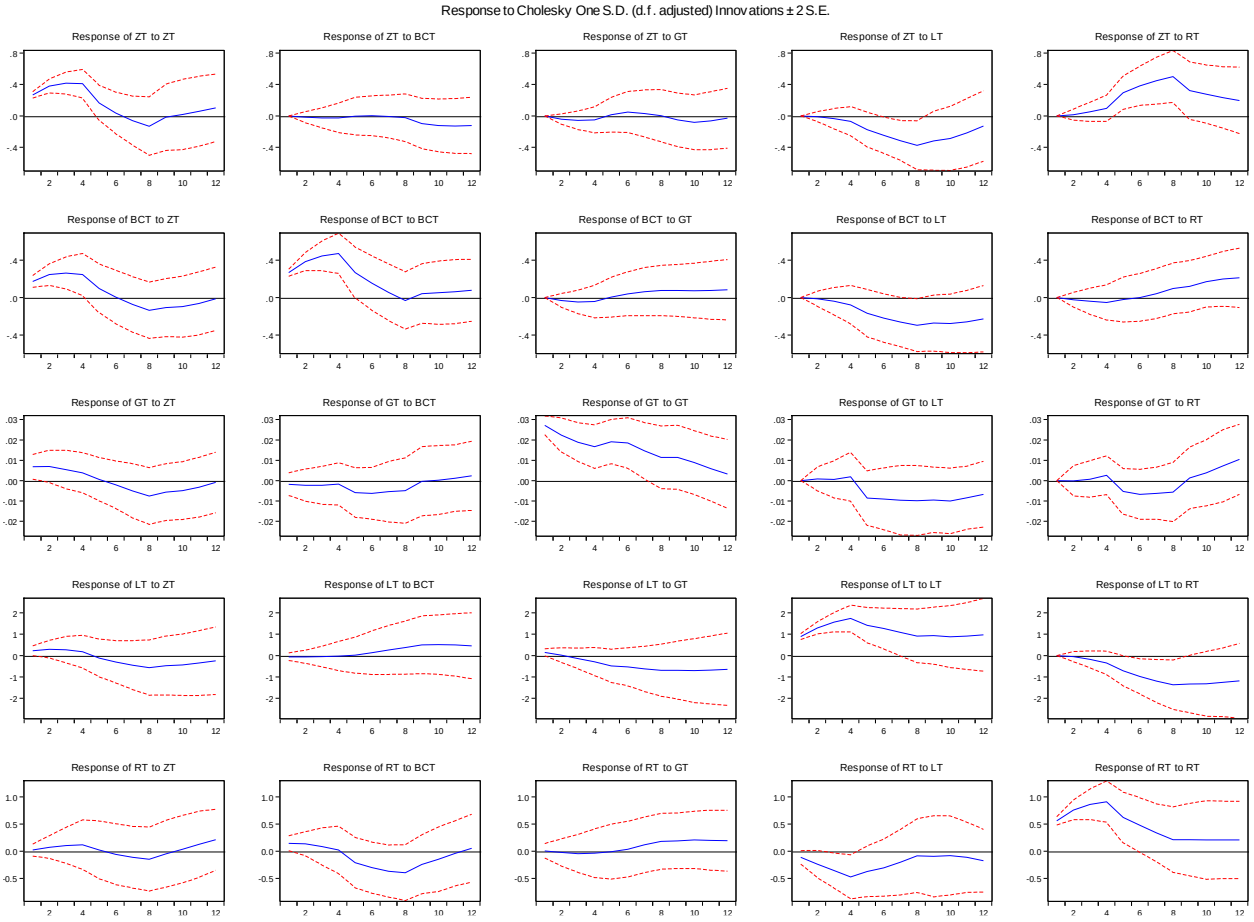
Null hypothesis: No

serial correlation at lag h

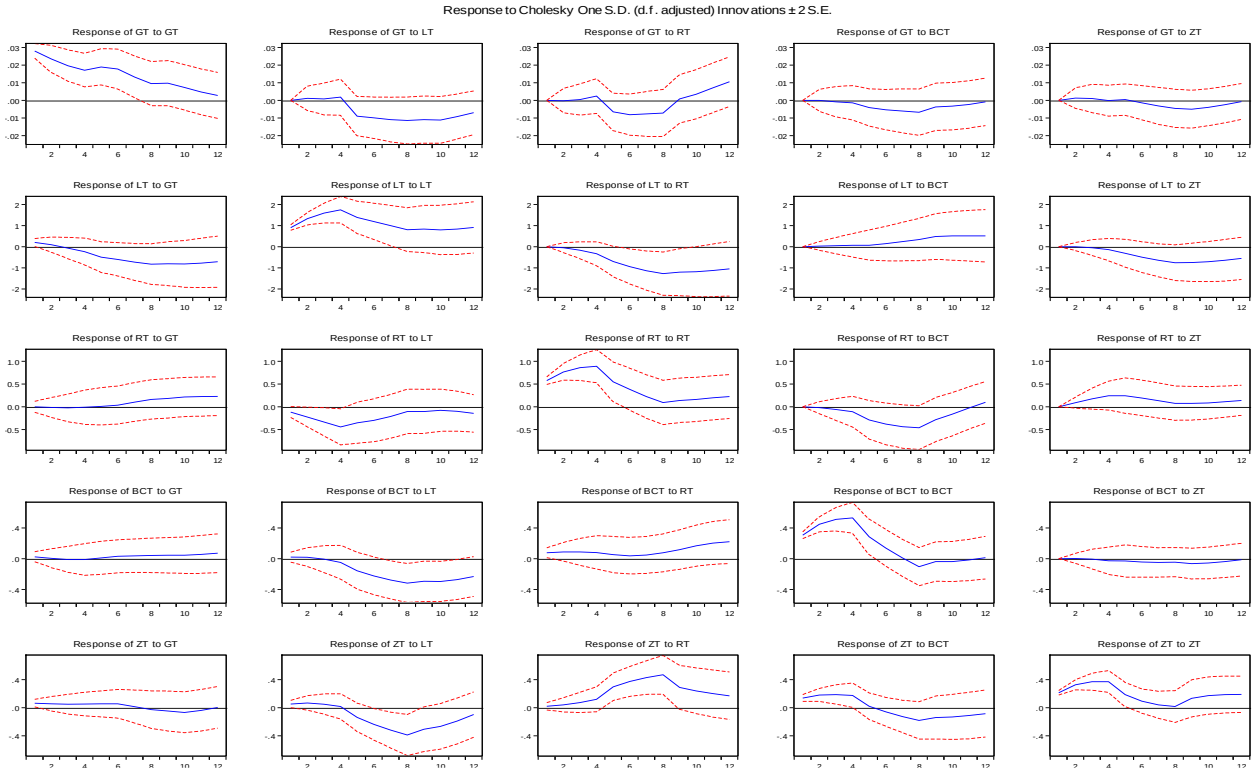
Lag	LRE* stat	df	Prob.	Rao F-stat	Df	Prob.
1	15.02629	36	0.9992	0.398757	(36, 204.8)	0.9992
2	8.610667	36	1.0000	0.225193	(36, 204.8)	1.0000
3	31.52552	36	0.6813	0.868875	(36, 204.8)	0.6842
4	158.9897	36	0.0000	5.961727	(36, 204.8)	0.0000
5	31.50061	36	0.6825	0.868138	(36, 204.8)	0.6854
6	23.51692	36	0.9458	0.636313	(36, 204.8)	0.9465

Appendix 7: Impulse Response Results

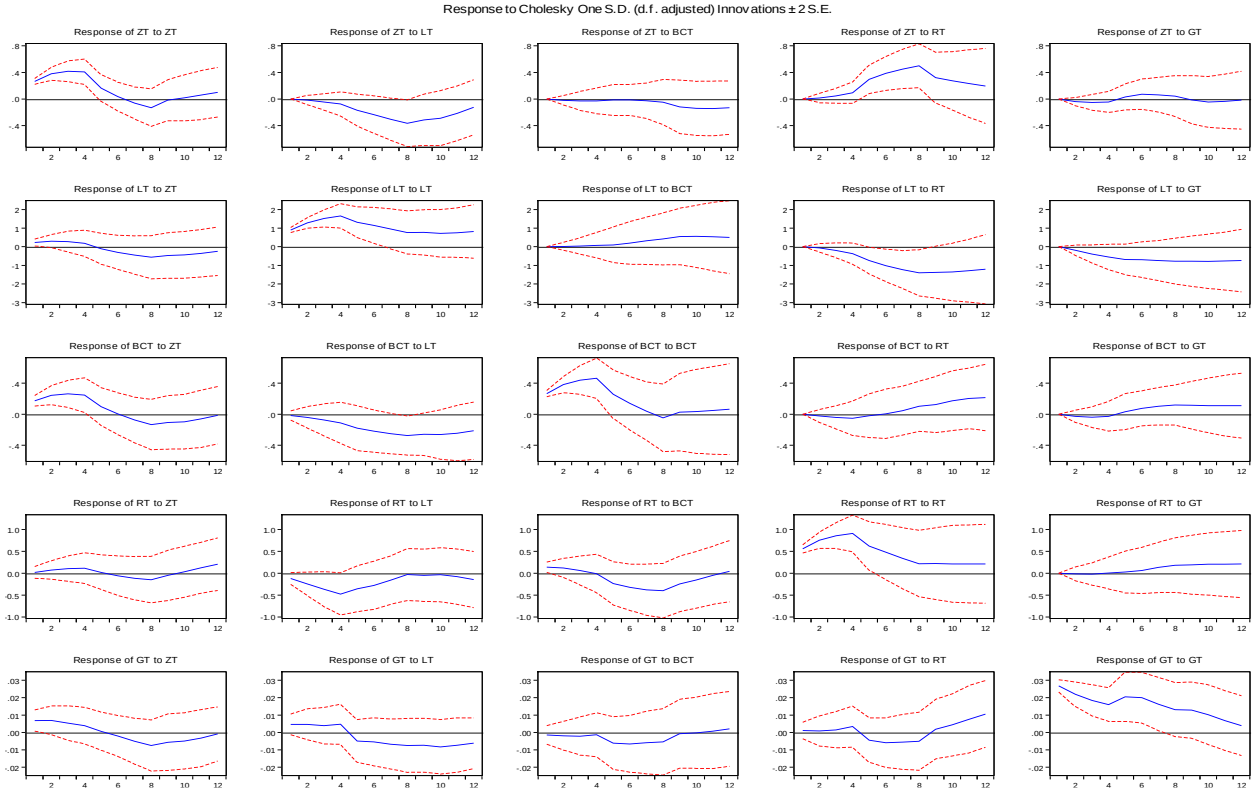
Appendix 7.1 : $[z_t,\ bc_t,\ g_t, l_t, r_t]$



Appendix 7.2 : $[g_t, l_t, r_t, bc_t, z_t]$



Appendix 7.3 : $[z_t, l_t, bc_t, r_t, g_t]$



Appendix 8: Result of Variance Decomposition

Variance Decomposition of ZT: Period	S.E.	ZT	BCT	GT	LT	RT
1	0.266682	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.466676	98.89539	0.146811	0.783390	0.058100	0.116304
3	0.631492	97.45664	0.249779	1.221232	0.367152	0.705192
4	0.763989	95.30006	0.280760	1.290120	1.047668	2.081394
5	0.853582	80.08394	0.227344	1.059950	5.040511	13.58826
6	0.968812	62.30668	0.176523	1.068033	10.41893	26.02983
7	1.114585	47.37529	0.138132	0.880740	15.80535	35.80048
8	1.283833	36.73578	0.139805	0.664062	20.39128	42.06907
9	1.365511	32.48919	0.630604	0.732395	23.42367	42.72414
10	1.429753	29.64958	1.316538	0.995284	25.36154	42.67706
11	1.472994	28.09044	2.011178	1.114234	26.06021	42.72394
12	1.500206	27.53907	2.608942	1.114879	25.84518	42.89193

Variance Decomposition of BCT: Period	S.E.	ZT	BCT	GT	LT	RT
1	0.316697	29.82816	70.17184	0.000000	0.000000	0.000000
2	0.555289	29.14744	70.34111	0.306889	0.045692	0.158868
3	0.761179	27.36751	71.43702	0.551109	0.289025	0.355345
4	0.933151	25.12093	72.88470	0.574879	0.876095	0.543393
5	0.990108	23.29476	72.01769	0.512563	3.650245	0.524742
6	1.026415	21.67946	69.24562	0.632463	7.954068	0.488390
7	1.065838	20.58733	64.48747	0.927576	13.39352	0.604105
8	1.121121	20.05050	58.36085	1.286811	19.01075	1.291096
9	1.168110	19.31482	53.88975	1.609891	22.94370	2.241837
10	1.219191	18.36360	49.64484	1.850864	26.16499	3.975704
11	1.267225	17.23201	46.20322	2.081568	28.34354	6.139668
12	1.309211	16.15574	43.63595	2.349151	29.52155	8.337600

Variance Decomposition of GT: Period	S.E.	ZT	BCT	GT	LT	RT
1	0.028108	5.878766	0.382672	93.73856	0.000000	0.000000
2	0.036675	7.029818	0.594402	92.32197	0.053136	0.000677
3	0.041676	7.120954	0.773411	92.00981	0.062624	0.033204
4	0.045204	6.781302	0.788264	91.81465	0.230555	0.385231
5	0.050453	5.460483	1.985994	88.07618	3.059528	1.417811
6	0.055279	4.683079	2.934491	84.52989	5.196808	2.655731
7	0.058787	4.878045	3.449418	80.94207	7.273870	3.456597
8	0.061601	5.938538	3.782409	77.14445	9.154260	3.980339
9	0.063630	6.343924	3.547336	75.54575	10.78759	3.775394
10	0.065309	6.587938	3.368856	73.55407	12.55032	3.938818
11	0.066591	6.577961	3.272983	71.51889	13.64913	4.981039
12	0.067860	6.351063	3.276181	69.09638	14.11963	7.156747

Variance Decomposition of LT: Period	S.E.	ZT	BCT	GT	LT	RT
1	0.929160	5.947813	0.349440	2.579548	91.12320	0.000000
2	1.622326	5.355780	0.234051	0.862349	93.43734	0.110475
3	2.279520	4.132781	0.166241	0.814890	94.22764	0.658451
4	2.903403	2.943042	0.108963	1.461479	93.64887	1.837652
5	3.345327	2.330370	0.084917	3.191196	88.41883	5.974682
6	3.758872	2.472600	0.188247	4.540796	81.30953	11.48882
7	4.171673	3.174669	0.537992	5.924002	72.80845	17.55489
8	4.586412	4.137142	1.102740	7.153576	64.23628	23.37026
9	4.962393	4.419553	1.955867	8.022391	58.39578	27.20641
10	5.300654	4.538701	2.642608	8.796822	53.95959	30.06228
11	5.596951	4.465937	3.153314	9.352676	51.03628	31.99179
12	5.858782	4.248520	3.480449	9.735364	49.30807	33.22759

Variance Decomposition of RT: Period	S.E.	ZT	BCT	GT	LT	RT
1	0.587299	0.107434	6.042375	0.004636	3.895757	89.94980
2	0.998090	0.556152	3.883055	0.063817	7.080422	88.41655
3	1.372120	0.862778	2.424157	0.141816	10.61315	85.95810
4	1.717209	1.008692	1.560881	0.140936	14.42906	82.86043
5	1.875862	0.857536	2.603867	0.121084	16.08546	80.33205
6	1.984390	0.853500	4.689627	0.137338	16.75778	77.56176
7	2.062390	1.098615	7.541690	0.432097	16.49964	74.42796
8	2.125681	1.521009	10.62673	1.122930	15.69217	71.03716
9	2.160981	1.523706	11.55816	1.848430	15.38082	69.68888
10	2.187125	1.511456	11.75160	2.684240	15.15181	68.90089
11	2.212579	1.798103	11.52024	3.416662	15.08131	68.18368
12	2.247493	2.596580	11.22098	4.036284	15.23976	66.90639

Cholesky Ordering: ZT BCT GT LT RT